# Geotechnical Engineering Investigation

### Langley Air Force Base F-22 Beddown Program Hampton, Virginia

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#### **EXECUTIVE SUMMARY**

This report presents the results of a geotechnical investigation prepared in support of Burns & McDonnell's design efforts for the proposed construction of the FY-02 F-22 Beddown Program Project at the Langley Air Force Base in Hampton, Virginia. This program includes the design and construction of a Low Observable restoration and Composite Repair Facility, an Airfield Lighting Vault, a Vertical Tank Storage Building, a Base Operations Facility, AMU Hangars, and Fire Protection Tanks. These facilities are to be constructed at various locations along the south side of the airfield. EEE Consulting, Inc. of Richmond, Virginia performed this investigation under contract to Burns & McDonnell of Kansas City, Missouri.

This investigation was performed to evaluate the geotechnical engineering conditions for the proposed structures. The scope of this investigation did not include the evaluation of environmental concerns related to soil or groundwater contamination.

The findings of our investigation are based on the results of a field reconnaissance, twenty-six geotechnical exploratory borings, field and laboratory tests, review of regional geologic and soils maps, and our engineering analysis of the collected data.

The soils encountered during the subsurface exploration of the site generally consisted of firm to stiff sandy and silty clay (CL) and very loose to medium dense silty sand (SM). These materials generally extended to depths of 5.0 to 10.0 feet. These materials were underlain by bluish gray; very loose to medium dense silty, very fine-grained sand (SM) which extended to the maximum depth explored in this investigation of 65 feet. Varying amounts of shell fragments and small whole shells were encountered in this silty, fine-grained sand layer.

The three primary considerations for foundation design at this site are the high water table, the layers of very loose sand encountered near the elevation of the water table (depth of 5 to 10 feet) and the proximity of existing masonry structures to the proposed facilities. The water table encountered in the exploratory borings ranged in depth from about 5 to 9 feet below the existing ground surface. This water table (which is typical for this area of Virginia) will limit the depths of excavations that can be made without the installation of temporary dewatering. A layer of very loose sand was encountered in almost all the borings at or near the groundwater elevation. These very loose sands extended from about 5 to 10 feet below the ground surface. This layer will be subject to settlement from loadings from the proposed structures. In addition, this layer will provide little support for foundation systems. Finally, the proximity of existing masonry structures to the proposed facilities may impact the type of foundation system selected or may affect the foundation system installation method. The nearby masonry structures may be subject to distress due to vibrations from the installation of some foundation systems (driven piles). In addition, there is an older brick structure located adjacent to the proposed fire protection tanks. Settlements induces by these tanks may cause settlement and cracking in this older structure.

Therefore, design recommendations for several foundation systems, including both deep and shallow foundations, are presented. The selection of the most appropriate system for each of the structures should be based on the structural requirements of the individual buildings. In general, the deep

foundation systems will be subject to limited settlements and will induce limited settlements to adjacent structures. Shallow foundations will be subject to some settlement but the cost of this type of foundation is significantly less than the deep foundation system.

We recommend that the AMU Hangar, the LO/CRF and the Base Operations Facility be supported on deep foundations. The Vertical Tank Storage and the Light Vault may be supported on spread footings provided the criteria for maximum foundation depth, presented in Section 4.2.2can be met. If this criterion can not be met then deep foundations will be necessary. The fire protection tanks may be supported on a ring wall for the shell and the bottom can be supported on grade. However, settlements on the order of 5 inches should be anticipated. These tanks need to be spaced away from existing structures and preloaded to induce the settlement prior to construction of the pump house.

Overall, the soils encountered during the subsurface investigation will be suitable for reuse as structural fill beneath foundations and pavements. Some petroleum contamination was encountered in the vicinity of the Base Operations Facility and the LO/CRF area. It is our understanding that this apparent release has been previously investigated and is well documented. Any contaminated soils or groundwater encountered should be properly handled and disposed.

The apparent groundwater table was encountered during the drilling at depths ranging from 5 to 9 feet below the existing ground surface. Because rotary wash drilling techniques were used to maintain the integrity of the boreholes, an accurate reading of the groundwater elevation at the completion of drilling was not obtained. However, based on our review of the laboratory test results, the standard penetration testing and our visual observations of the collected soil samples, we estimate that the stabilized groundwater surface is at a depth of about 7 feet below the existing ground surface

The soils at the site exhibit soaked California Bearing Ratio (CBR) values ranging from 3.8 to 12.8 when compacted to a minimum of 98 percent of the standard Proctor maximum dry density (moisture contents approximately 1 to 2 percent dry of the optimum moisture content). These CBR values represent actual test results and should be appropriately reduced or recalculated based on applicable pavement design method.

#### 1.0 INTRODUCTION

This report presents the results of a geotechnical investigation prepared in support of Burns & McDonnell's design efforts for the proposed construction of the FY-02 F-22 Beddown Program Project at the Langley Air Force Base in Hampton, Virginia. This program includes the design and construction of AMU Hangars, a Low Observable Restoration and Composite Repair Facility, an Airfield Lighting Vault, a Vertical Tank Storage Building, a Base Operations Facility, and Fire Protection Tanks. These facilities are to be constructed at various locations along the south side of the airfield. Figure 1 presents the general facility layout and regional topography. EEE Consulting, Inc. of Richmond, Virginia performed this investigation under contract to Burns & McDonnell of Kansas City, Missouri.

This investigation was performed to evaluate the geotechnical engineering conditions for the proposed structures. The scope of this investigation did not include the evaluation of environmental concerns related to soil or groundwater contamination.

This report is provided for the sole use of Burns & McDonnell and the U.S. Army Corps of Engineers and their designated representatives. Use of this report by any other parties is not authorized and will be at such party's own risk. EEE Consulting disclaims liability for use or reliance of this report by other parties.

#### 1.1 SITE DESCRIPTION

The proposed F-22 Beddown Facilities are located along the south side of the Langley airfield. Figure 1 (overall Site Plan and Area Topography) shows the approximate locations of the proposed facilities. The Low Observable Restoration and Composite Repair Facility (LO/CRF) and airfield lighting vault are the only structures that will be located in an area that has not been previously developed. The LO/CRF is located in a grass area immediately north of the Base Fire Station and the lighting vault will be located immediately north of the LO/CRF. The grass area is located between the Flightline Road to the south and west, the tarmac to the north, and an unused runway to the east. The new Base Fire Station is located south of Flightline Road. The Base Operations Facility will be located immediately west of the airfield tower in the location of the old fire station. The old fire station was previously demolished and the concrete slabs are all that remain. The AMU hangars will be located where hangars 754, 755, and 756 are currently located. The fire protection tanks will be located in a parking lot immediately adjacent to Building 782. The proposed locations of these structures are shown on the attached site plans (Figures 2, 3, and 4)

The airfield is located at an elevation of 11 feet mean sea level (msl). There is very little relief across the sites of the proposed construction. The ground surface elevations at the individual exploratory boring locations ranged from 4.18 to 8.55 feet msl. Elevations of the individual borings are presented on the boring logs presented in Appendix A.

#### 1.2 PROPOSED CONSTRUCTION

The proposed project consists of the construction of several new structures, including: AMU Hangars, a Low Observable Restoration and Composite Repair Facility, an Airfield Lighting Vault, a Vertical Tank Storage Building, a Base operations Facility, and a Fire Protection Tank(s).

The project includes a new six-bay Squadron Operations/AMU Hangar with adjoining maintenance shops, an administration area and a squadron support section for the new F-22 multi-role fighter. The six-bay aircraft maintenance hangar will be an open structure that is framed with steel roof trusses. The two-story squadron operations and AMU areas will be framed with conventional hot-rolled shapes for beam and column members. Interior and perimeter column loads for the squadron operations building are anticipated to be 175 kips and 80 kips for dead plus live loads, respectively. Column loads for the AMU Hangar are anticipated to be 150 kips for dead plus live loads with maximum loads of 250 kips and minimum loads of -150 kips when including wind loadings. Perimeter wall loadings are anticipated to be 1,300 psf. The maximum anticipated lateral loading will be on the order of 30 kips.

The Base Operations Facility will be a one-story structure framed with conventional hot-rolled shapes for beams and columns. It is anticipated that maximum loads will be 60 kips and minimum loads of -15 kips including wind loading. The perimeter wall loads are anticipated to be 1,300 psf. The maximum anticipated lateral loading will be on the order of 8 kips.

The Low Observable Restoration and Composite Repair Facility will include a three-bay area for composite materials maintenance and repair/wash areas for the new F-22 multi-role fighter. The aircraft maintenance wash bays will be framed with steel roof trusses. Maximum and minimum vertical loading in the shop area are 35 and -15 kips, respectively. In the hangar areas the maximum and minimum vertical loadings are anticipated to be 45 and -45 kips, respectively. The maximum anticipated lateral loading in this area will be on the order of 15 kips. The perimeter wall loadings are anticipated to be 1,300 psf.

Two water tanks used for fire protection will be located adjacent to the pumphouse. A third tank will also be located in this area that will be used for foam. The tanks are anticipated to be 22 feet in diameter and 24 feet high with a capacity of 67,000 gallons. It is anticipated that the exterior structure of the tanks will be supported on a ring wall and that the tanks will have a flexible bottom.

#### 1.3 OBJECTIVES AND SCOPE OF WORK

The objectives of this study were to evaluate subsurface conditions in the vicinity of the proposed structures and to develop geotechnical engineering recommendations to guide design and construction of foundations and adjacent pavements. Burns & McDonnell requested that the geotechnical investigation include twenty-six exploratory borings. The anticipated boring depths ranged from 5 feet below the existing ground surface (BGS) to 65 feet bgs. The maximum depth explored during this investigation was 65 feet. To accomplish these objectives, the following tasks were performed:

- 1. Twenty-six exploratory borings (17 for analysis of structures and 9 for analysis of pavements) were drilled to depths ranging from 5 feet (for pavement evaluations) to 65 feet to explore the subsurface conditions and to provide soil samples for laboratory testing.
- 2. A geotechnical engineer classified collected soil samples in the field.
- 3. Laboratory tests were performed to measure pertinent soil properties including soil strength and classification.
- 4. Engineering analysis of the field and laboratory data was made to develop recommendations for foundation design and construction.

It should be noted that specific pavement designs were not requested as part of this investigation. Laboratory testing was performed on near-surface soil samples to evaluate the California Bearing Ratios (CBR) of these materials. These values can be used along with traffic information to develop appropriate pavement designs. Table 4 presents a summary of the CBR test results; the detailed laboratory CBR results are presented in Appendix B.

The scope of this investigation included evaluation of the geotechnical engineering conditions for the proposed structures. This scope did not include the evaluation of environmental concerns related to soil or groundwater contamination.

### 1.4 REVIEW OF PREVIOUS REPORTS ADDRESSING THE OLD BASE FIRE STATION

Following the issuance of the Draft Geotechnical Engineering Investigation for the F-22 Beddown Project in mid-March 2001, five reports that addressed the old Base Fire Station were made available for review. These reports addressed observed distress in the old Base Fire Station, which was located where the Base Operations Facility is to be constructed. This structure was apparently demolished sometime in the recent past. All that remains of the previous structure are the interior floor slabs. References to these previous reports are presented below. In addition, generalized findings of the reports pertinent to this geotechnical investigation are presented in Section 3.4 of this report.

"Engineering Study of Building 375, Langley AFB, Virginia, Contract DACA65-86-D-0001", Prepared by MacIlroy and Parris, Architects, P.C. and St. Clair, Callaway & Frye, Engineers, dated June 12, 1986.

"Structural Investigation, Fire Station – Building 375", prepared for the Department of the Air Force, Langley Air Force Base, prepared by The CEGG Partnership, Architects – Engineers – Surveyors, dated July 1989.

"Advanced Subsurface Investigation Report for the Base Fire Station, Building 375 at Langley Air Force Base, Virginia", prepared for Waller Todd & Sadler, prepared by Metcalf & Eddy, dated April 18, 1990.

"Structural Investigation Report for Base Fire Station, Building 375 at Langley Air Force Base, Virginia", prepared for Waller Todd & Sadler, prepared by Metcalf & Eddy, dated June 28, 1990.

"Final Report on Structural Analysis of Base Fire Station, Langley Air Force Base, Virginia", prepared for Waller Todd & Sadler, prepared by Metcalf & Eddy, dated October 23, 1990.

A brief summary of the pertinent geotechnical findings of these reports as they relate to the design and construction of the proposed Base Operations Facility are presented in Section 3.4 of this report.

#### 2.0 METHODS OF INVESTIGATION

Subsurface soil conditions at the site were evaluated by drilling twenty-six exploratory borings with a truck-mounted drill rig using rotary wash drilling techniques. Seventeen of the borings were drilled to depths ranging from 25 to 65 feet and nine were drilled to a depth of five feet. The locations of the borings are shown on Figures 2, 3, and 4. The borings were drilled with a BK-41C truck-mounted drill rig using rotary wash drilling techniques. Detailed descriptions of the soils encountered are presented on the attached boring logs in Appendix A.

During the geotechnical investigation, subsurface soils encountered in the borings, were sampled and used to evaluate foundation conditions for structures. Samples were obtained continuously to a depth of 10 feet, and at approximately 5-foot intervals, thereafter. The soils were sampled by driving a 2-inch diameter split barrel sampler into the soil with a 140-pound hammer free falling 30 inches using standard penetration test (SPT) procedures. The SPT borings were completed in general accordance with guidelines established in ASTM D-1586. Driving resistances for the split-barrel sampler are recorded on the attached boring logs (Appendix A). In addition, two relatively undisturbed samples of silty sand encountered in the borings were sampled with a thin-walled tube sampler (Shelby tube). Representative portions of the split spoon sample and Shelby tube samples were sealed and packaged in the field and delivered to a geotechnical engineering laboratory in Richmond, Virginia for classification and strength testing.

The laboratory testing program was directed primarily towards classification properties of the soils encountered in the borings. Prior to transport to the laboratory for testing, a geotechnical engineer visually classified the samples. Bulk samples of near surface soils were obtained from Borings LO-5, LO-6, BO-1, BO-1A, BO-4, BO-5, BO-6, AMU-7, and AMU-8. Laboratory testing of eight of these bulk samples consisted of standard Proctor and California Bearing Ratio (CBR) tests. The results of these tests were used to evaluate compaction properties of the soil and to provide soil strength data for the pavement design. Natural Moisture Content, Percentage Passing the No. 200 Sieve, and Atterberg limits tests were performed on selected jar samples obtained from borings within the building footprints for purposes of classification of the soil. In addition, a triaxial shear test was performed on an undisturbed Shelby tube sample to aid in the evaluation of the strength of the subsurface soils for deep foundation design. The following tests were performed as part of the laboratory program:

- ❖ Natural Moisture Content Test (ASTM D-2216),
- ❖ Percentage finer than the No. 200 sieve (ASTM D-1140),
- ❖ Atterberg limits test (ASTM D-4318),
- ❖ Triaxial shear test CU (with pore pressure measurements) (ASTM D-2850)
- ❖ Standard Proctor compaction test (ASTM D-698), and
- California Bearing Ratio (CBR) test (ASTM D-1883).

The moisture content testing was performed on the near surface soils to assist with the evaluation of the depth to the water table and the suitability of excavated soils as structural fill. Moisture content determinations were also performed in several of the borings to the maximum depths explored. The purpose of this testing was evaluate how consistent these soils were with depth.

The results of the laboratory tests are presented in Appendix B.

#### 3.0 SITE CONDITIONS

#### 3.1 REGIONAL GEOLOGY AND MAPPED SOILS

The site is located within the Atlantic Coastal Plain physiographic province. The mapped surficial soils belong to the Lynnhaven Member (Figure 5). The Lynnhaven soils are described as pebbly and cobbly, fine to coarse gray sand grading upward into clayey silty fine sand and sandy silt. In the area of the Langley AFB, the total thickness of the Lynnhaven soils varies from about 5 to 15 feet. These surficial deposits are underlain by the soils of the Yorktown formation. The Yorktown formation is Miocene in age. The top of the Yorktown formation typically consists of a relatively thin layer of bluish gray to gray highly plastic clay. This layer typically acts as an aquaclude between the overlying soils and the underlying Yorktown soils. The underlying soils of the Yorktown formation typically consist of bluish gray to gray, fossiliferous, medium dense silty sands, and firm to very stiff sandy silts and silty clays. Shell beds are often abundant in this formation.

#### 3.2 SUBSURFACE CONDITIONS

A total of twenty-six exploratory borings were drilled across the area of proposed development to investigate the subsurface conditions. Seven borings, in which SPT testing was conducted, and 2 shallow probes, from which bulk samples were obtained for CBR testing, were drilled in the AMU Hangar area. Two borings and five probes were drilled around the Base Operations Facility, four borings and two probes were drilled in the LO/CRF area, two borings were drilled for the vertical tank storage facility, one boring was drilled for the light vault and one boring was drilled for the Fire Protection Tanks. The locations of the borings and probes were selected by Burns & McDonnell in consultation with EEE Consulting. Field personnel from EEE located the borings in the field by taping and pacing from known landmarks. The locations of the proposed structures and the exploratory borings are shown on Figures 2, 3, and 4.

Many of the borings were located in areas of asphalt or concrete pavement. Prior to drilling, the pavement was cored to limit the disturbance to the surrounding pavement surface. Table 3 summarizes the surface conditions at each of the boring locations. In general, the concrete around the proposed Base Operations Facility was observed to have a thickness that ranged from 4.5 to 10.5 inches. In the AMU Hangar area four of the borings had surface materials that consisted of asphalt overlying concrete. In these areas the pavement section consisted of 2.25 to 3 inches of asphalt over 6 to 8.5 inches of concrete. Two of the borings encountered only asphalt. In this case, the asphalt thickness ranged from 3 to 4 inches.

The subsurface conditions encountered in the exploratory borings were relatively uniform across the entire study area. In the AMU Hangar area the near surface soils consisted of firm to stiff sandy and silty clay (CL) and very loose to medium dense silty sand (SM). These materials generally extended to depths of 5.5 to 8.0 feet. These surface soils were underlain by bluish gray, very loose to medium dense silty, very fine grained sand (SM) which extended to the maximum depth explored in this area of 65 feet. Varying amounts of shell fragments and small whole shells were encountered in this layer.

The near surface soils encountered in the area of the Base Operations Facility generally consisted of medium dense, clayey and silty sands (SC and SM) and stiff silty, clay (CL). These materials extended to depths of about 11 to 12.5 feet below the ground surface. A distinct petroleum odor was noted in samples from each of the borings at depths of about 4 to 8 feet. The near surface soils were underlain by bluish gray, loose silty, very fine grained sand (SM) which extended to the maximum depth explored in this area of 45 feet. Varying amounts of shell fragments and small whole shells were encountered in this layer.

Four borings were drilled in the LO/CRF area, two were drilled in the Vertical Tank Storage Area and one was drilled for the light vault. All three of these proposed facilities are in the same general area. The soils in this area generally consisted of very loose to medium dense, clayey and silty sand (SC/SM) which extended to depths of about 5 to 9 feet. In boring LO-2 the top four feet of soil consisted of stiff to very stiff, silty, clay fill soil. A petroleum odor was detected in a sample from a depth of 6 feet in LO-2. This depth generally coincided with the depth of the water table in the area. This material was underlain by very loose to loose silty sand (SM) that extended to the maximum depth explored in this area of 50 feet. Varying amounts of shell fragments and small whole shells were encountered in this lower layer.

One boring was advanced in the area of the proposed fire protection tanks. This boring generally encountered medium dense, silty sand (SM) that extended to a depth of about 4 feet. This material was underlain by very loose to loose silty sand (SM) that extended to the maximum depth explored in this area of 50 feet. Varying amounts of shell fragments and small whole shells were encountered in this lower layer.

#### 3.3 GROUND WATER

Seventeen of the borings drilled as part of this investigation were advanced to a sufficient depth to encounter the ground water table. The apparent groundwater table was encountered during the drilling at depths ranging from 5 to 9 feet below the existing ground surface. Because rotary wash drilling techniques were used to maintain the integrity of the boreholes, an accurate reading of the groundwater elevation at the completion of drilling was not obtained. The depth to groundwater has been inferred from the results of the standard penetration tests and the moisture content determinations. Based on the review of laboratory soil moisture content data, the results of the standard penetration testing, and our visual observations of the collected soil samples, we estimate that the stabilized groundwater surface is at a depth of about 7 feet below the existing ground surface. However, in this area the groundwater is likely influenced by the tides resulting in daily groundwater elevation fluctuations of 1 to 2 feet. Therefore, for design purposes, a groundwater elevation of 5 feet below the existing ground surface should be assumed. The borings were backfilled with cement bentonite slurry immediately following the drilling operations. It should be noted that fluctuations in the ground-water level may also occur due to variations in rainfall, temperature and other factors not evident within the short duration of this subsurface investigation.

#### 3.4 REVIEW OF PREVIOUS REPORTS FOR THE OLD BASE FIRE STATION

In March 2001, EEE was provided with five engineering reports that addressed observed distress in the old Base Fire Station. These reports presented results of extensive investigations, which included the drilling of exploratory borings, laboratory analysis of soil and groundwater samples and structural evaluations of the building.

In summary, the final report prepared by Metcalf & Eddy, dated October 23, 1990 concluded that failure of the soils underlying the building foundations was not the cause of the distress observed in the structure. The analyses lead to the general conclusion that the predominant cause of the damages and deformations was horizontal expansion of the concrete pavement adjacent to the north side of the building (this was apparently former Taxiway 7). It was concluded that the horizontal expansion of this former taxiway was thermally induced and was compounded by pavement joint deficiencies and insufficient maintenance of the existing expansion joints in the concrete. Metcalf & Eddy recommended that a repair program be immediately implemented to return the structure to a satisfactory condition, and that a rebuild program be initiated for implementation within the next five years.

The October 23, 1990 report also presented depth to groundwater data from eight borings/monitoring wells located in the immediate vicinity of the old Base Fire Station. The depths to groundwater reported ranged from 5.4 to 7.0 feet below the existing ground surface (which is consistent with the results presented in Section 3.3 of this investigation).

#### 4.0 GEOTECHNICAL RECOMMENDATIONS

The following recommendations are based on a review of the attached boring logs and laboratory data, EEE's understanding of the proposed construction, and past experience with similar projects and subsurface conditions. Should the proposed development plans or structural conditions differ significantly from those on which our recommendations are based, EEE should be allowed the opportunity to review and evaluate the findings of this report so that the recommendations may be confirmed, extended, or modified as necessary. Should subsurface conditions be encountered during construction that are different from those encountered in this investigation, then those differences should be reported to EEE for review and evaluation.

The three primary considerations for foundation design at this site are the high water table, the layers of very loose sand encountered near the elevation of the water table (depth of 5 to 9 feet) and the proximity of existing masonry structures to the proposed facilities. The water table encountered in the exploratory borings ranged in depth from about 5 to 9 feet below the existing ground surface. This water table (which is typical for this area of Virginia) will limit the depths of excavations that can be made without the installation of temporary dewatering. A layer of very loose sand was encountered in almost all the borings at or near the groundwater elevation. These very loose sands extended from about 5 to 10 feet below the ground surface. This layer will be subject to settlement from loadings from the proposed structures. In addition, this layer will provide little support for foundation systems. Finally, the proximity of existing masonry structures to the proposed facilities may impact the type of foundation system selected or may affect the foundation system installation method. The nearby masonry structures may be subject to distress due to vibrations from the installation of some foundation systems (driven piles). In addition, there is an older brick structure located adjacent to the proposed fire protection tanks. Settlements induces by these tanks may cause settlement and cracking in this older structure.

Therefore, design recommendations for several foundation systems, including both deep and shallow foundations, are presented below. The selection of the most appropriate system for each of the structures should be based on the structural requirements of the individual structures. In general, the deep foundation systems will be subject to limited settlements and will induce limited settlements to adjacent structures. Shallow foundations will be subject to some settlement but the cost of this type of foundation is significantly less than the deep foundation system.

We recommend that the AMU Hangar, the LO/CRF, and the Base Operations Facility be supported on deep foundations. The Vertical Tank Storage and the Light Vault may be supported on spread footings provided the criteria for maximum foundation depth, presented in Section 4.2.2 can be met. If this criterion can not be met then deep foundations will be necessary. The fire protection tanks may be supported on a ring wall for the shell and the bottom can be supported on granular materials placed and compacted within the ringwall. However, settlements on the order of 5 inches should be anticipated. These tanks need to be spaced away from existing structures and preloaded to induce the settlement prior to construction of the pump house.

#### 4.1 EARTHWORK

#### 4.1.1 Site Grading

Due to the relatively flat topography of the area, it is likely that the site grading to establish building pads will be minimal. It is our understanding that the design plans for some of the structures have column bases located below the adjacent concrete slab floors. This may result in some excavations on the order of 4 to 6 feet in depth. Soils generated by these excavations will be suitable for re-use as structural fill provided these materials are not contaminated or otherwise environmentally unsuitable. Some petroleum contamination was encountered in the borings drilled in the LO/CRF and the Base Operations Facility areas. It is our understanding that separate environmental evaluations have been performed for this apparent release. Soils generated from excavations in these areas should be evaluated for contamination and, if contaminated, disposed of properly (environmental sampling and testing of soil and groundwater was outside the scope of this investigation).

Soils derived from on-site cutting or excavation operations (excluding topsoil) would be suitable as structural fill (except as noted above). However, due to the relatively high ground water table, cut soils may require drying prior to placement as structural fill. Details regarding the placement and compaction of structural fill are presented in Section 4.1.4 Structural Fill.

Site work should begin with the clearing of all vegetation and topsoil or the demolition and clearing of debris from existing structures, from those areas designated for construction of the new facilities. All vegetation, topsoil, and debris should be removed from the site. Holes resulting from the removal of existing foundation elements or other underground obstructions should be properly backfilled with compacted structural fill soil. Following stripping operations, areas at grade or designated to receive fill should be proofrolled with a partially-loaded dump truck or similar piece of rubber tired equipment to identify those areas requiring repair. Any area which ruts or pumps excessively in the opinion of the geotechnical engineer should be repaired in the field as directed by the geotechnical engineer prior to the beginning of fill operations. Based on our observation and SPT information, it does not appear that large quantities of undercut will be required except where saturated soils are encountered.

Other than organic topsoil, the need for undercutting is directly related to the moisture condition of natural soils at the time earthwork is initiated. The natural near-surface soils are moderately well drained but may become soft and difficult to compact during the typically wetter winter months of November through April or May. In addition, during these wetter months it is very difficult to dry soils that are above the optimum moisture content. To avoid delays during site grading operations, we recommend earthwork activities be scheduled after May and prior November, if possible, to facilitate site grading work.

#### 4.1.2 Excavation Considerations

Based on our discussions with Burns & McDonnell it appears that some excavation work for column bases and pile caps (on the order of 4 to 6 feet) may be required for the proposed facilities. The

primary considerations for site excavations are the relatively high ground water level and the possibility of caving of the sides of the excavations. As excavations get closer to the groundwater table (approximately 5 feet below the existing ground surface) soil moisture content will increase dramatically and the consistency of the soils will become looser (softer). Excavations that extend below a depth of about 5 feet will likely encounter groundwater seeps and very soft excavation bases. During our subsurface investigation "running" sands were not encountered in the borings. In open cut situations some of these sands may exhibit a tendency to run. In addition, some of the near surface soil layers encountered may tend to slough when exposed in vertical cuts. Ultimately, the need for and design of temporary shoring and dewatering should be the sole responsibility of the contractor. All excavations should conform to applicable OSHA guidelines for safety considerations.

#### 4.1.3 Ground-Water Control

Based on ground-water observations during the field investigation, ground-water control should not be a significant issue provided the excavations are limited to depths of 5 feet below the existing ground surface. The loose, saturated, fine grained sands extending from a depth of about 5 feet to 10 feet bgs can produce significant quantities of water and the exposed soils <u>may</u> tend to "run" when exposed in open cuts. The contractor should be prepared to install temporary shoring and dewatering for any excavations that may encounter the water table. The ultimate determination of the need for temporary shoring and its design should be the sole responsibility of the contractor. In addition, the design of temporary dewatering systems should be the responsibility of the contractor.

If temporary or permanent excavations are planned that extend below an elevation equivalent to 5 feet below the existing ground surface, then water proofing and/or sump pumps should be anticipated.

During the exploratory drilling apparently contaminated soils were encountered in some of the borings drilled for the LO/CRF and the Base Operations Facility. If groundwater is encountered in these areas during construction it may be contaminated and require special handling and disposal. It is our understanding that a number of environmental studies have been conducted in association with this contamination. We recommend that these studies be reviewed prior to construction. In addition, it would be prudent to require the testing of the groundwater prior to construction. During the field portion of this investigation a number of monitoring wells were noted in this area that would provide a means of obtaining groundwater samples.

#### 4.1.4 Structural Fill

All saturated and/or organic laden topsoil materials and petroleum contaminated soils should be considered as unsuitable for reuse as structural fill and should be removed from the building area and disposed of properly. Overall, the soils encountered at the site will be suitable for reuse as structural fill beneath foundations and pavements. Prior to placement of the fill the natural soils should be scarified to a minimum depth of 6 inches. This scarification will provide adequate meshing of placed fill materials at the fill interface which will minimize the potential of shear failure. All fill material placed on the site should be compacted to at least 95 percent of the modified Proctor

maximum dry density (ASTM D 1557) except in the final 12-inches beneath pavements and floor slabs where this requirement should be increased to 98 percent of the modified Proctor maximum dry density. Fill material should be placed in thin lifts not to exceed 8 inches (loose measure) and compacted within 2 percent of the optimum moisture content. The project specifications should require testing of each lift of fill to confirm the required degree of compaction is achieved. A Nuclear Moisture Density Gauge (NMDG) will be suitable for compaction testing of on-site material if used as structural fill. Alternative methods of testing compaction (Sand Cone - ASTM D1556-90 or Drive Cylinder - ASTM D 2937-90) may be utilized periodically for verification of the accuracy of the NMDG test results during placement of structural fill. For earthwork volume considerations, a shrinkage factor of 10 to 15 percent is recommended when virgin soils are recompacted as engineered fill.

If off-site soils are used as structural fill, the materials best suited for this use are either a low plasticity clay (e.g., silty or sandy clay - CL) or relatively clean sands (SM, SC, SP, SW). Low plasticity clays should have plasticity indices and liquid limits less than about 25 and 45, respectively. Granular soils (sand) should have less than 40 to 50 percent passing the No. 200 sieve (percent fines). While soils can be used which have properties outside these limits, the higher the plasticity (plasticity index and liquid limit), and the more fines (percent passing the No. 200 sieve), the more moisture sensitive and the more difficult to compact. High plasticity clays and silts should not be used as structural fill.

#### 4.1.5 Utility Installation

EEE recommends utility pipes be placed directly over at least 6 inches of open-graded crushed stone, such as No. 57 stone or clean sand to provide a leveling cushion and a stable base for the pipe. If very soft, unstable soil conditions are encountered at the invert elevation, the trenches should be overexcavated approximately 12 inches and replaced with clean sands or open graded stone. Determination of the need to undercut unsuitable soils should be made during construction by the geotechnical engineer or experienced senior soil technician.

All backfill placed over the pipe should be compacted to at least 95 percent of the modified Proctor maximum dry density except in the final foot beneath pavements or building subgrades where the requirement should be increased to 98 percent of the modified Proctor maximum dry density. If the soil cannot be compacted beneath and adjacent to the pipe, stone should be used for backfill. The initial lift of soil backfill over the pipe should consist of material not containing large pieces of rock or weathered rock to serve as a cushion over the pipe for subsequent fill placement and compaction. Additionally, in-place density tests should be performed to confirm backfill compaction requirements are being met. Most soils removed from the excavation may be utilized as backfill providing they can be suitably compacted. Shallow excavations should hold a neat vertical line for temporary trench cuts; however, all excavations should be in accordance with applicable OSHA regulations for safety to workmen.

#### 4.1.6 Seismic Potential

The proposed site lies within a band which extends up the east coast of the Mid-Atlantic states rated as Zone 1, as determined by the U.S. Coast and Geodetic Survey. This rating system ranges from 0 (no damage) to 3 (major damage) and estimates the seismic risk in the United States. Zone 1 is defined as being only a slight risk of minor damage due to a major earthquake. The probable frequency of occurrences of major earthquakes was not considered in assigning ratings to the various zones; however, the proposed site is not in a high-intensity-earthquake-prone area of the United States.

#### 4.2 FOUNDATION DESIGN AND ANALYSES

The primary geotechnical considerations for foundation design are the layer of very loose to loose sands that are present from a depth of about 5 to 10 feet beneath the ground surface, the high water table, and the presence of old masonry buildings (near some of the structures) that may be damaged by construction related vibrations. In order to accommodate these design constraints, EEE is presenting multiple foundation recommendation alternatives. These alternatives represent both shallow and deep foundation systems. These recommendations will give the project designers the necessary information to select the appropriate foundation system for each structure.

Our review of design information for structures in the immediate vicinity of the proposed F-22 Beddown Facilities indicates that both shallow spread footings and timber piles have historically been used. It is our understanding that the old Fire Station, which is the location of the proposed Base Operations Facility, was supported on shallow spread footings. Although the old Fire Station experienced significant distress over its lifetime, the general conclusion developed by Metcalf & Eddy was that the distress was related to thermal expansion of an old adjacent taxiway and not on foundation failure. However, Metcalf & Eddy stated that it was likely that any future structures in this area should be supported on a deep foundation system. The new Fire Station, which is located approximately 600 feet south of the proposed LO/CRF and about 1,000 southeast of the old Fire Station, is founded on timber pile foundations.

We have received conflicting information regarding the foundations supporting the existing hangars located in the area of the proposed AMU Facility. We were initially informed that these structures were supported on shallow spread footings. However, we were recently informed that these buildings might actually be supported on timber piles. To date, we have not reviewed any documentation that could confirm either foundation type. We recommend that the foundation system supporting these structures be determined. The foundation type will affect the cost to demolish the structures that are to be removed. In addition, the type of foundation will affect the susceptibility of the remaining structures in the immediate area to possible vibration and settlement induced damage.

#### 4.2.1 Driven Pile Foundations

Our review of design information for structures in the vicinity of the proposed F-22 Beddown

Facility indicates that timber piles have historically been the deep foundation system of choice. However, it is our experience that pre-stressed concrete piles are being used more frequently and are becoming more affordable for these types of facilities. In addition, some of the design lateral loads may push the limits of the lateral capacity of timber piles.

Because both timber and pre-stressed concrete piles are a form of displacement pile they may be prone to premature refusal. Therefore, we recommend that piles to be used at this facility be relatively short -25 feet. Pre-drilling of the piles to a depth of 15 feet will reduce driving induced vibrations without significantly affecting the pile load carrying capacity. The diameter of the pre-drill hole should be no greater than 2/3 of the diameter of the pile (for 12-inch square concrete piles the maximum pre-drill hole is 8-inches).

The Soil Survey for the area indicates that the mapped soils in the vicinity of the site possess a moderate to high corrosion potential. Due to the mapping of high corrosion potential soils at the site EEE recommends that the piles be adequately corrosion protected prior to installation. Corrosion protection for concrete piles may include such measures as the use of Type II cement, air entrainment, or corrosion inhibitor additives. It is our conclusion that cathodic protection is not required. In addition, we recommend that timber piles be treated to resist decay with bitumen or an equivalent compound.

The subsurface investigation revealed a very loose to loose layer of fine grained, silty sand that generally extended from 5 to 10 feet below the existing ground surface. This soft layer appears to be directly related to the presence of the water table in this zone. Below a depth of 10 feet the soils generally became loose to medium dense, silty sands. From a depth of about 10 feet beneath the existing ground surface combination friction and end bearing piles will develop the load carrying capacity.

The allowable load carrying capacity of the two pile types recommended are presented in Table 1. These calculations have been made assuming both end bearing and skin friction contribute to the pile capacity for compression. Ideally, piles should be spaced with a minimum of three (3) pile diameters (center to center) between adjacent piles. At this spacing the full capacity of the pile should be available. If piles are spaced closer than 3 pile diameters there is a greater likelihood that the driving operations will cause shifting of the adjacent, previously installed piles. In no case should piles be spaced closer than 2 pile diameters.

		Axial and Lat F-22 Bed	Table 1 eral Pile Capaci down Program Air Force Base	ties	
Pile Type	Pile Length (ft)	Axial Compression Capacity (FS=3)	Axial Compression Capacity (FS=2)	Axial Tension Capacity (FS=3)	Lateral Load Capacity (0.5 inch deflection) Brom's Method
Timber Pile (Minimum tip diameter 8-inches)	25	9 tons	13 tons	5 tons	0.4 tons single pile free head condition 0.7 tons single pile fixed head condition
Pre-stressed Concrete Pile (12x12 inch square)	25	17 tons	25 tons	7.5 tons	1.5 tons single pile free head condition  3.0 tons single pile fixed head condition

With these loading conditions we estimate the settlement of the individual piles as less than 0.25 inches.

It is possible to increase the axial pile capacities presented in Table1 by driving the piles deeper. However, if the piles are driven deeper to achieve greater axial capacities a larger pile hammer will likely be required which would increase the vibrations induced by the pile driving. These increased vibrations may adversely impact adjacent structures. Soil conditions, pile hammer, and pile type directly influence the pile driveability. A practical limit for timber pile length is about 60 feet with an upper limit for axial pile capacity is about 50 tons.

It has been our experience that the fine sand soils that underlie the site tend to set-up over short periods of time. Thus, retapping of the piles if required may be difficult.

The allowable lateral load carrying capacity of the individual piles has been calculated for both the fixed and free head conditions and is presented in Table 1. In the free head condition, the assumptions of no load eccentricity and an allowable lateral deflection of 0.5 inches at the ground surface were used.

It is our understanding that Burns & McDonnell intend to employ the computer program LPILE Plus to evaluate the lateral load carrying capacities of the piles for the AMU structures. Table 2 presents recommended soil input values for this area of the site.

	La	iteral Ca	pacity Dete Pile Fo			· ·	put	
Depth Range (ft)	Soil Type	Navg	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)	Phi angle (degrees)	Cohesion (psf)	k (pci)	E <sub>50</sub>
Represe	ntative Bo	rings A	MU-3, 4, 9					
0-4	CL/SC	12	95	110	0	1,000	250	0.006
4-11	SM/SP	<4	75	110	30	0	20	0
>11	SP	8	87	115	34	0	60	0
Represe	ntative Bo	rings A	MU-1, 2, 5,	6				
0-5	CL/SC	9	95	110	0	1,000	250	0.006
5-15	SM/SP	<4	75	10	30	0	20	0
>15	SP	8	87	115	34	0	60	0

Pile foundations should be driven with a hammer having adequate rated energy to overcome the driving resistance during installation. Once a hammer is selected, a wave equation analysis should be performed to evaluate the hammer properties. We recommend that at least one pile load test be performed prior to installation of all the piles for any given structure. The installation of the test pile should be performed with the equipment proposed for production installation. The installation of the test pile and as well as the pile load test should be performed under the observation of a geotechnical engineer. We recommend that load testing be performed no sooner than 10 days following the pile driving to allow for dissipation of excess pore pressures from the soil around the pile.

It is our understanding that Burns & McDonnell intend to require pile load testing at each of the building locations. By requiring field load testing, a factor of safety of 2 may be applied to the measured ultimate pile capacity to arrive at the allowable pile capacity (UBC 1997). This methodology for determining the allowable pile capacity is acceptable and will provide a more accurate measurement of the true allowable pile capacity. For initial design purposes, the axial capacities presented in Table 2 using the Factor of Safety of 2 may be used.

In areas where existing structures are located near the proposed construction we recommend vibration monitoring of these existing structures during the pile driving. The vibrations produced by the driving operations may cause cracking in some of these older masonry structures. At a minimum, a crack survey of the adjacent structures should be performed before commencement of the pile driving. The purpose of this monitoring should be to assist in the assessment of the effects of the pile driving on the adjacent structures. It is our opinion, that a structural engineer should be consulted regarding the type and frequency of vibration monitoring. We anticipate that predrilling for the piles should reduce the possibility of producing vibrations that could cause damage to the structures.

To the extent possible, the installation of the piles should be a continuous operation without termination of driving until the point of acceptable resistance or embedment is achieved. The silty sands of the Yorktown formation tend to set following pile driving operations, thus making re-

driving difficult. Pile driving within a given pile group, should begin at the center of the group and progress outward to reduce hard driving of interior piles due to soil densification (this is especially important for prestressed concrete piles). If piles experience heave or rise of more than ¼ inch after driving, they should be re-driven to seat the tip of the pile in the bearing stratum.

It is recommended that all piles be driven in the presence of a geotechnical engineer experienced in pile driving. If premature refusal of the piles is encountered, we recommend that a pile driving analyzer be used to evaluate hammer efficiency and energy prior to approving early cut off. During the pile installation, the following quality control observations should be performed by the geotechnical engineer:

- ❖ Observe the pile installation equipment and report non-conformance to the specifications
- ❖ Continuously observe the pile installation
- \* Have knowledge of the soil conditions at the site and the required penetration of each pile
- \* Record and report movement of previously installed adjacent piles
- ❖ Observe piles prior to installation for any obvious defects
- . Count and record the blows per foot during the driving
- Recommend halting of driving operations when unanticipated difficulties or conditions are encountered

#### 4.2.2 Shallow Foundations

Should the designers determine that deep foundations are not required for the Vertical Tank Storage or the Lighting Vault the following shallow foundation recommendations should be employed. It should be noted that mixing deep and shallow foundations for the same structure may result unsatisfactory differential settlement in the structure.

Conventional continuous and isolated spread footings bearing (on undisturbed native soils or) on compacted fill may be used at the designers discretion. All footings should be founded at least 18 inches below the nearest adjacent finished grade. In addition, footing excavations should not be extended to depths greater than 2.5 feet below the existing ground surface so as to not encounter the water table or the loose (soft) soils associated with the water table. If deeper excavations are required, shallow foundations should not be considered an appropriate foundation alternative. Footings located adjacent to other footings or utility trenches should have their bearing surfaces situated below an imaginary 1.5 horizontal to 1 vertical plane projected upward from the bottom of the adjacent footing or utility trench.

At the above depths, the footings may be designed for an allowable bearing pressure of 1,500 pounds per square foot due to dead loads, 1,875 pounds per square foot due to dead plus live loads and 2,250 pounds per square foot for all loads including wind or seismic. The allowable load capacity calculated for dead loads includes a factor of safety of 3.0. The allowable bearing pressures are net values; therefore, the weight of the footing can be neglected for design purposes. All footings should have a minimum width of 14 inches, and all continuous footings should be tied together with reinforcing steel. Footings should not have a minimum horizontal dimension less than 12 inches. Maximum anticipated settlements of shallow foundations are 1.25 inch with a maximum differential

settlement of approximately 0.6 inches.

All continuous footings should be designed with adequate top and bottom reinforcement to provide structural continuity and to permit spanning of local irregularities. Any visible cracks in the bottoms of the footing excavations should be closed by wetting prior to construction of the foundations. To assure that footings are founded on appropriate material, we recommend that a geotechnical engineer observe the footing excavations prior to placing steel or concrete.

Lateral load resistance may be developed in friction between the footing bottom and the supporting subgrade. A friction coefficient of 0.30 is considered applicable. As an alternative, a passive resistance equal to an equivalent fluid weighing 300 pounds per cubic foot acting against the foundations may be used. If the foundations are poured neat against the soil, friction and passive resistance may be used in combination.

#### 4.2.3 Fire Protection Tank Ring Wall

We recommend that the exterior shell of the fire protection tanks be supported on a shallow strip footing bearing on compacted fill. Prior to construction two feet of structural fill soil should be placed in the tank area to provide a smooth uniform base for footing and tank support. The footing should be founded at least 18 inches below the lowest adjacent finished grade. In addition, the footing should be founded no greater than 3 feet below the existing ground surface. If deeper excavations are required, a shallow foundation may not be an appropriate foundation alternative. If the footing is located adjacent to other footings or utility trenches its bearing surface should be located below an imaginary 1.5 horizontal to 1 vertical plane projected upward from the bottom of the adjacent footing or utility trench.

At the above depths, the strip footing may be designed for an allowable bearing pressure of 1,500 pounds per square foot due to dead loads, 1,875 pounds per square foot due to dead plus live loads and 2,250 pounds per square foot for all loads including wind or seismic. The allowable load capacity calculated for dead loads includes a factor of safety of 3.0. The allowable bearing pressures are net values; therefore, the weight of the footing can be neglected for design purposes. The strip footing should have a minimum width of 14 inches and should be tied together with reinforcing steel.

The interior of the ring wall should be backfilled with compacted granular structural fill to provide uniform support for the bottom of the tank.

All continuous footings should be designed with adequate top and bottom reinforcement to provide structural continuity and to permit spanning of local irregularities. Any visible cracks in the bottoms of the footing excavations should be closed by wetting prior to construction of the foundations. To assure that footings are founded on appropriate material, we recommend that a geotechnical engineer observe the footing excavations prior to placing steel or concrete.

Lateral load resistance may be developed in friction between the footing bottom and the supporting subgrade. A friction coefficient of 0.30 is considered applicable. As an alternative, a passive resistance equal to an equivalent fluid weighing 300 pounds per cubic foot acting against the

foundations may be used. If the foundations are poured neat against the soil, friction and passive resistance may be used in combination.

The fire protection tanks will have flexible bottoms with the exterior shell supported on a ring wall (strip footing). Total settlement induced by the loaded tank will be on the order of 5 inches. Consolidation testing was not performed on the fine-grained sands encountered beneath the site. However, a consolidated undrained (CU) triaxial shear test was performed on a sample of these materials obtained from the AMU area. EEE reviewed the consolidation data obtained from the triaxial test and performed a rough calculation of the time rate of settlement. Based on these calculations it is our opinion that 90 percent of the total settlement should be realized approximately six to eight weeks following the filling of the water tanks.

In order to confirm the magnitude and rate of settlement, it is still EEE's recommendation that survey-monitoring points be established around the perimeter of the tank ring walls (minimum of 4 points evenly spaced around each ring wall) prior to the initial filling of the tanks. The tanks should then be filled with water and allowed to settle. During this time period surveys of the benchmarks on the ringwall should be performed at least weekly to measure the settlement. A graph of settlement vs. time should be generated as an aid in evaluating when the primary settlement of the tanks is complete. These points should be monitored at least weekly.

In order to minimize damage to existing structures in the area and damage to the proposed pump house we recommend that the tanks be located a minimum of 40 feet from the existing brick building. In addition, the tanks should be constructed prior to construction of the pump house or connection of permanent piping to the tanks.

#### 4.2.4 Retaining Walls for Pit Excavations

In the case of retaining wall design for pits, EEE recommends the use of an at rest earth pressure ( $K_o$ ) equal to 0.60. For the soil conditions present at the site, we recommend an active earth pressure ( $K_a$ ) equal to 0.40. Active earth pressures should only be used in cases where the retaining walls are considered unrestrained. In the case of pits within structures, the retaining walls should be considered restrained.

If the structural engineer determines that there are surcharge loads on the walls, the walls should be designed to resist an additional uniform pressure equivalent to one-half or one-third of the maximum anticipated surcharge load applied to the surface behind restrained or unrestrained walls, respectively.

The above pressures assume that sufficient drainage will be provided behind the walls to prevent the build-up of hydrostatic pressures from surface and subsurface water infiltration. In cases where there is the possibility of the retaining wall extending below the water table or where perched water may accumulate behind the retaining wall, hydrostatic pressures should be added to the design soil pressures.

Walls constructed above the seasonal high water table may be designed with adequate drainage to avoid superimposing a hydrostatic load. Adequate drainage may be provided by an underdrain system consisting of a four-inch rigid perforated pipe bedded in 3/4-inch clean, open-graded rock. The entire rock/pipe unit should be wrapped in an approved non-woven, polyester geotextile. The rock and fabric placed behind the wall should be at least one foot in width and should extend to within one foot of finished grade. The upper one-foot of backfill should consist of on-site, compacted, impervious soils. Flexible, perforated pipe is not acceptable pipe for use in the underdrain system. The underdrain pipe should be connected to a system of closed pipes that daylight from behind the wall. As an alternative to the underdrain system a series of weep-holes constructed at the bottom of the wall may be used. The construction of weep-holes through the wall will eliminate the need for the underdrain pipe behind the wall.

#### 4.2.5 Interior Floor Slabs-On-Grade

We recommend that interior floor slabs be supported on a minimum of 6 inches of granular fill soil. The slabs may be designed for an assumed subgrade modulus of 90 pci in cut areas. This subgrade modulus may also be used in fill areas provided the upper 12 inches of the fill soil is compacted to a minimum of 95 percent of the modified Proctor maximum dry density. Prior to final construction of the slab, the subgrade surface should be proof-rolled to provide a smooth, firm surface for slab support. The slabs should be appropriately reinforced according to structural requirements; concentrated loads may require additional reinforcing.

In areas where floor wetness would be undesirable, 4 inches of free draining gravel should be placed beneath the floor slab to serve as a capillary barrier between the subgrade soil and the slab. In order to minimize vapor transmission, an impermeable membrane should be placed over the gravel.

We also recommend that the specifications for slab-on-grade floors require that moisture emission tests be performed on the slab prior to the installation of any flooring. No flooring should be installed until acceptable moisture emission levels are recorded for the type of flooring to be used.

#### 4.2.6 Exterior Slabs-On-Grade

Exterior slabs-on-grade (pavement areas) should be supported by a minimum of 6 inches of compacted granular backfill. The slabs may be designed for an assumed subgrade modulus of 90 pci in cut areas. This subgrade modulus may also be used in fill areas provided the upper 12 inches of the subgrade is compacted to a minimum of 95 percent of the modified Proctor maximum dry density. Prior to final construction of the slab, the subgrade surface should be proof-rolled to provide a smooth, firm surface for slab support. Any areas that exhibit pumping or rutting during proofrolling should be repaired by undercutting the area and backfilling with either washed stone or properly compacted soil.

#### 4.3 PAVEMENT DESIGN PARAMETERS

EEE has not been provided specific traffic loading information for this project. However eight samples of the near surface soils were obtained for California Bearing Ratio Testing (CBR). The

results of the CBR testing are discussed below with some general pavement design recommendations and presented in summary form on Table 4.

Six of the CBR tests produced values in the range of 4.2 to 6.4. Two of the tests produced CBR values of 10.4 and 11.0. During the bulk sampling of the soils for the testing, it was observed that some of the samples contained small pieces of gravel which were likely mixed into the soil matrix during the original construction operations. It is EEE's opinion that these small gravel pieces affected the CBR values in the two samples with the higher CBR values. For design purposes, EEE recommends that the lower CBR values be used. These values represent actual test results on existing materials at specific locations and should be appropriately reduced or recalculated based on applicable pavement design method.

Our subsurface investigation did not reveal the presence of previous subgrade stabilization beneath the existing pavements.

Pavement performance is directly related to subgrade support characteristics; therefore, the need for subgrade preparation immediately prior to base course placement is reemphasized as a necessary operation to provide a significant pavement service life.

Additionally, based on our experience with other projects in the area, we caution against operating heavy construction equipment on a partial pavement section. Numerous pavement failures and reduced pavement life have been observed at other facilities due to significant construction traffic operating on a reduced pavement section in which the final asphalt wearing course had not been placed. The omission of the final wearing course reduces the structural number of the pavement section such that the pavement section does not have suitable strength for supporting heavy loads. If the contractor chooses to delay placement of the final wearing course of asphalt until after completion of the majority of construction, we recommend that an increased pavement section be utilized to provide adequate support for the construction traffic.

## Table 3 SUMMARY OF BORING LOCATION SURFACE CONDITIONS F-22 BEDDOWN PROGRAM

Boring Location	Boring Number	Surface	Asphalt	Concrete
. 140 27 14		Conditions	Thickness	Thickness
AMU Hangar	AMU-1	grass	***	***
AMU Hangar	AMU-2	grass	***	***
AMU Hangar	AMU-3	grass	***	***
AMU Hangar	AMU-4	asphalt	3 inches	6.5 inches
AMU Hangar	AMU-5	asphalt	1.25 inches	7 inches
AMU Hangar	AMU-6	asphalt	1.5 inches	6 inches
AMU Hangar	AMU-7	asphalt	2.25 inches	8.5 inches
AMU Hangar	AMU-8	asphalt	4 inches	none
AMU Hangar	AMU-9	asphalt	3 inches	none
LO/CRF	LO-1	grass	***	***
LO/CRF	LO-2	grass	***	***
LO/CRF	LO-3	grass	***	***
LO/CRF	LO-4	grass	***	***
LO/CRF	LO-5	grass	***	***
LO/CRF	LO-6	grass	***	***
Base Operations	BO-1	concrete	none	10.5 inches
Base Operations	BO-1A	concrete	none	10.0 inches
Base Operations	BO-2	concrete	none	7 inches
<b>Base Operations</b>	BO-3	concrete	none	4.5 inches
Base Operations	BO-4	asphalt	3.5	none
Base Operations	BO-5	grass	***	***
Base Operations	BO-6	grass	***	***
Vertical Tank				
Storage	VT-1	grass	***	***
Vertical Tank				
Storage	VT-2	grass	***	***
Light Vault	LV-1	grass	***	***
Fire Protection				
Tanks	PÒ-1	asphalt	3 inches	none

## Table 4 Summary of California Bearing Ratio Tests F-22 Beddown Program

		Maximum	Optimum	California Bearing Ratio					
Boring No.	Sample Depth (ft)	Dry Density (pcf)	Moisture Content (%)	0.1 inch penetration	0.2 inch penetration				
LO-5	1-5	116	14	5.5	5.2				
LO-6	1-5	117	12.5	5.5	6.5				
BO-1	1-5	113.9	15	10.4	9.2				
BO-1A	1-5	114	16	5.9	4.9				
BO-5	1-5	108.5	18	5.0	4.4				
BO-6	1-5	115	13.5	6.4	5.7				
AMU-7	1-5	118.5	11.5	11.0	12.8				
AMU-8	1-5	119	13.4	4.2	3.8				

APPENDIX A

**BORING LOGS** 

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	ve Density rained Soil, SAND		sistency   Sul, Silt or Clay
N-Value	Relative Density	N-Value	Relative Density
0.4	Very Loose	G-1	Very Soft
5- \ū	Loose	2-4	Soft
11-30	Medium Dense	5-8	Afedium Stiff
31-50	Dense	9-15	Sulf
Cc<	Very Densa	16-29	Very Stiff
		>29	Hard



Dry No apparent moisture, dusty.

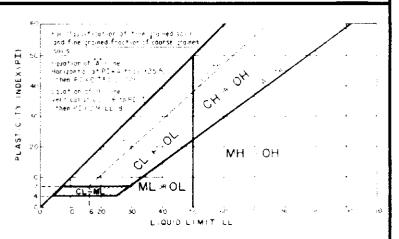
Dainp Apparent moisture, below the Plastic Limit

Mo st Significant moisture, at or above the Plastic

Limit (can be rolled into a 1/8\* thread)

Wet Appears saturated, free water

in voids and pores.



#### **Further Descriptors**

Mot led Irregularly marked with patches of different colors, vanegated

, and an about of a maganes

Michaeous Contains the mineral mica.

Relict Rock Distinct pattern of mineralization

Structure from parent rock.



Key to Soil Classification (Based on Unified Soil Classification System)

	سن ب		SO	IL BOR	EHC	LE	LC	G			_					
SITE	NAME	F	LOCATION: F-22 Beddown Facility	DRILLING ME started dril of QuickG	lling @	nud i 8 fe	rotary et, us	witled a	n tricone about 1/4	bit I bag	_	RING AM		мве	R	
•			_angley Air Force Base Hampton, Virginia			HOD: Split Spoon Sampler						page 1 of 2				
		•	nampton, vagana	with 2 turr			<del></del>		•		1	DRIL				
BORI	NG L	OCATI	ON:									ART		FIN	ISH	
				WATER LEV	EL	6.0						IME		TIN 2:		
PROJ	ECT	NUMB	er: 00-062	DATE		1:45					+	:30	+			
DATU	M· FT	MSI	GROUND ELE.:4.18 ft	CASING DE	DTH	1/17/0	01					ATE 7/01			ATE 7/01	
		: CMI		OAGING DE		CF CC		IONS	grass							
		LE:		<u> </u>					: Fishbા	ırne	Drillin	g, In	<b>C</b> .			
SAMP	LE H	AMME	R TYPE: 140# safety hamme	r	LOGGI							J				
z	~	34	DEADERTIC		) er	TEST	RES	JLTS	P	NETF	RATION	RES	ISTA	NCE		
DEPTH IN FEET	SAMPLER	LITHOLOGY	DESCRIPTION OF		BLOWS per	WATER CONTENT %	LIQUID LIMIT %	Ϋ́СΙΤ		10	20	30 40	)	60	80 10	
DEP FE	AMF	된	MATERIAL		ĮŠ Č	WAT	LIM	PLASTICITY INDEX								
	S										<del> </del> -	Щ	<del>+</del>	<del>   </del>	<del></del>	
•			CLAY(CL), sandy, silty mediu													
	┝┼┤	+	with wood fragments, gray		"-				/	/						
•			CLAY (CL), sandy, medium to stiff,													
- - 5			gray		11				:	1						
5	<u> - </u>				-1						Ì					
_			SAND(SC), v. fine-grain very loose to loose, gray		2											
-	$\sqcap$		rounded pebbles	, ICW	2	35										
- -10	Ш		·						\							
- 10 -			Percent finer than No. 2	00 = 21.8%					\							
					· <b>-</b> -				\							
_	$\vdash$		SAND(SM), v. fine-grain	ed, silty, ve	ry 4				\							
-			loose to loose, bluish gra	ay, few shel	~											
<b>-</b> 15 -			fragments			1										
<del></del>												11				
_			Percent finer than No. 2	00 = 15.1%												
_					5	35			\							
-20	╫												İ			
<u> </u>			•						1							
_		4				ļ			1							
_					7					\				11		
<del>-</del> 25	-	-	few shell graments and	small intact	t											
Ē			shells													
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<b>– 30</b>	$\coprod$	1							1							
L								1								
	<u> </u>						<u> </u>	<u> </u>	<u> </u>							

			SO	IL BOR	Εŀ	10	LE	LC	G							
SITE	NAMI		LOCATION: F-22 Beddown Facility	started dri	lling	)D: n	nud r 8 fee	otary et, us	/ wit	h tricone bit about 1/3 ba	ag .	BOR	NG N		BER	
			Langley Air Force Base	of QuickG												
			Hampton, Virginia	SAMPLING M						· · · · · · · · · · · · · · · · · · ·		page 2 of 2				
DODU		0047	ION.	with 2 turn	ns c	of ro	oe o	n the	cat	nead	$\dashv$		RILLI	_		
BORII	NG L	OCATI	ION:	1414 TED 1 E) 1	ATED LEVEL		~ ~	1		<u> </u>	_	STA TIM		<del> </del>	INIS	
BB0 II	FOT			WATER LEV TIME	EL		6.0	╁╌			$\dashv$	1:30		1	TIME 2:10	
PROJ	ECT	NUMB	ser: 00-062	DATE			1:45				$\dashv$	DAT			DAT	
DATUI	M: FT	MSL	GROUND ELE.: 4.18 ft	CASING DEPTH						$\dashv$	1/17			/17		
DRILL	. RIG	: CM	 E	<u> </u>	su	RFA(	CE CC	NDIT	IONS	grass				-		
DRILL										R: Fishburne	e Dr	illing	Inc.			
			R TYPE: 140# safety hamme	r		GGE	D BY:	М. 1	hon	nas						
Z	~	λS	DECORIDE		Ī	ē Ģ		RESI	JLTS	PENE	TRA	TION F	RESIS	TANG	CE	
DEPTH IN FEET	LEF	Ž	DESCRIPTION OF			NS.I	ÄÄ NT%	diu 7.	 ES	1	0 2	20 30	40	60	81	0 100
DEF	SAMPLER	LITHOLOGY	MATERIAL			BLOWS per FOOT (N)	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX							
					$\exists$		i			\			$\dashv$		$\forall$	
_			(continued) SAND(SM), v. fine-grained, silty, very	/ Inose to						\						
_			loose, bluish gray, few s													
- 1			fragments			12					\					
35-						-										
			Bottom of Boring @ 35'													
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			SO	IL BOR	EHO	)LE	E L	)G					
SITE	NAM		F-22 Beddown Facility	DRILLING ME started dri of QuickG	lling @	mud ) 8 fe	rotar et, u	y wit	h tricone bit about 1/4 bag	BORING	NUM 1U-2		
1			Langley Air Force Base Hampton, Virginia	SAMPLING MI		Split	Spo	on S	ampler	page	= 1 o	f 2	
			•	with 2 turr						DRIL			一
BOR	ING L	OCA1	TION: AMU Building							START		FINIS	
				WATER LEV	EL	7.0				11:15		TIME 12:20	
PRO	JECT	NUME	BER: 00-062	DATE		11:3 1/17/0				<u> </u>	+		
DAT	JM: F	T MSL	GROUND ELE.: 6.21	CASING DE	PTH	17 1 770	<del>" -</del>			DATE 1/17/01	1	DATI /17/0	
DRIL	L RIG	: CM		1 0/10/110		CE C	ONDIT	IONS	grass	1	<u> </u>		
			90°						R: Fishburne	Drilling, Inc	 >.		
			ER TYPE: 140# safety hamme	r	LOGG				****	<u> </u>			
<u>z</u>	0	β	DECODIDATION		ž S	TES	RES	ULTS	PENET	RATION RESI	STAN	CE	
DEPTH IN FEET	NEF	ΣŎ	DESCRIPTION OF		NS F	R K	LIQUID	¥ë	10	20 30 40	60	80	100
ם	SAMPLER	гітногосу	MATERIAL		BLOWS per	WATER CONTENT %	35	PLASTICITY INDEX					
	1 T	<del>                                     </del>		<del> </del>	<del>-  </del> -	<del></del>			\			11	##
<b>-</b>			SAND(SC), v. fine-grained slightly silty, medium dense		17	9				/			
Ĺ		1	gray and brown	o, motiou						/			
	П	]	SAND(SC), very fine grain		- 11	23							
<b>–</b> 5			medium dense, mottled ye	llow brown	17	20	47	29		\			
			and gray <u>Percent finer than No. 200</u>	= 32.7%	5	33							:
<b>-</b>		1	SAND(SM), very fine-gr	ained									
_ _10			slightly clayey, very loos dense, bluish gray		n   4	34							
_			dones, blaish gray						$  \ \  $				
F	$\vdash$	1	Percent finer than No. 2	100 = 16 8%	, 8	35							
-15	$\perp$		r ercent inter than No. 2	.00 - 10.0%	,   0								
-			·										
<u> </u>		1			7	37							
-20	Ш	_			'	-							
<b> </b>													
-													
L	Т	1			8	33							
_ <sub>25</sub>			trace shells in sample @	D 25'	l °	ادد			\				
<b> </b>				- <del></del>					\				
F													
• ,	$\vdash$								<b> </b>				
L <sub>30</sub>					11	35			ľ				
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<u>L</u>				·*									

			SO	IL BOR	EH	10	LE	LC	G								
SITE	NAMI	l	LOCATION: F-22 Beddown Facility	DRILLING ME started dri of QuickG		): m @	ud i 8 fe	rotary et, us	wit sed a	h tricone bit about 1/3 ba	ag	BOR		NUI /U-	MBE	R	
			Langley Air Force Base Hampton, Virginia	SAMPLING MI		D: 5	Split	Sno	on S	ampler	[	page 2 of 2					
		'	riampton, virginia	with 2 turns of rope on the cathead						_	DRILLING				$\dashv$		
BORI	NG L	OCATI	ION:	VIII. 2 (01)	10 01	10,	-		Juc	- Iouu		STA		T		ISH	-
				WATER LEV	EL	T	7.0				1	TIM	ΛĖ	1	TI	ME	
PROJ	ECT	NUMB	BER: 00-062	TIME		1	1:30	2	·			11:	15		12	:20	
			0.01	DATE		1	/17/0	)1				DA				ATE	
DATU	M: FT	MSL	GROUND ELE.: 6.21	CASING DE	PTH			_				1/17	//01		1/1	7/0	1
DRILL							_			grass							
DRILL										R: Fishburn	e Dri	lling	, In	<u>C.</u>			_
	LE H/		R TYPE: 140# safety hamme	Γ				M. T									_
<u>₹</u> .	۲	<u>≽</u>	DESCRIPTION		þe	FOOT (N)	æ	RESU		PENE							
DEPTH IN FEET	SAMPLER	LITHOLOGY	OF		WS.	5	WATER CONTENT 9	LIQUID LIMIT %	PLASTICITY INDEX	1	0 2	0 3	0 40	1	60 T T	80	100
8	SAN	풀	MATERIAL		BLO	김임	CON	35	PLAS								Ш
		<u> </u>			$\pm$					*				$\frac{1}{1}$	艹	÷	卅
- - - - 35			SAND(SM), very fine-grained, sligh clayey, very loose to medium dense bluish gray			10	34										
-40 -40			Percent finer than No. 2	00 = 22.5%		15	33 <sup>1</sup>										
-45 - - - - -50			few shells from 44'			34											
- - - -55 -					2	21	36										
<del>-60</del> - -			Bottom of Boring @ 60'			19	36										

SO	IL BOR	EHC	LE	L	)G	······			
SITE NAME AND LOCATION: F-22 Beddown Facility	DRILLING METHOD: mud rotary with tricone bit started drilling @ 8 feet, used about 1/4 bag of QuickGel SAMPLING METHOD: Split Spoon Sampler with 2 turns of rope on the cathead						BORING NUMBER AMU-3		
Langley Air Force Base Hampton, Virginia							page	page 1 of 3	
• •							DRILLING		
BORING LOCATION:	WATER LEVEL 6.0					START TIME	FINISH		
PROJECT NUMBER: 00-062	WATER LEV	EL	6.0 12:3	_			12:00	1:30	
PROJECT NUMBER, 00-002	DATE		1/18/0				DATE	DATE	
DATUM: FT MSL GROUND ELE.: 6.55 ft	CASING DE	PTH					1/18/01	1/18/01	
			SURFACE CONDITIONS Grass						
DRILL ANGLE: 900						R: Fishburne (	Orilling, Inc.		
SAMPLE HAMMER TYPE: 140# safety hamme	<b>51</b>								
SAMPLER SAMPLER OF THIN OR OF MATERIAL MATERIAL		BLOWS per FOOT (N)			_	10	20 30 40		
SAMPLER DESCRIPTION OF MATERIAL MATERIAL		N   N   N   N   N   N   N   N   N   N	FOOT (N WATER CONTENT%	LIMIT % ASTICITY INDEX	PLASTICITY INDEX	1	70 00 40		
U S S		8.	_8		3_				
SAND (SC), v. fine-grain medium dense, gray  Percent finer than No. 2  SAND(SM), v. fine-grain loose, gray with yellow in the percent finer than No. 2  SAND(SM), very fine-grain loose, bluish gray  trace small shells and shells and shape sh	00 = 36.2% ned, silty, nottles 00 = 19.2% ained, silty	7 4 6 9	36	30	14				

	SO	L BOR	EHC	LE	L	OG						<del></del>
	F-22 Beddown Facility	DRILLING ME started dri of QuickG	lling @	nud 8 fe	rotar et, u	y wit	h tricone t about 1/3	oit oag	BORIN	IG NU		ĒR
	Langley Air Force Base Hampton, Virginia	SAMPLING MI		Split	Spo	on S	Sampler		pag	je 2	of 3	
	, tampion, tinginia	with 2 turr			<u> </u>			1		RILLIN		
BORING LOCAT	ION:								STAR	_		NISH
	00.000	WATER LEV TIME	EL	6.0	_				TIME 12:00			ME :30
PROJECT NUMB	ER: 00-062	DATE		12:3 1/18/0			<u> </u>		DATE			ATE
DATUM: FT MSL	GROUND ELE.: 6.55 ft	CASING DE		17 10/0	21			$\neg$	1/18/0	- 1		8/01
DRILL RIG: CM			SURFA	CE C	DNDIT	IONS	grass					
DRILL ANGLE:					**-		R: Fishbur	ne Di	illing,	Inc.		
	R TYPE: 140# safety hamme	<u> </u>	LOGGE		M.			CTD (	710117	-0105	4.1.0-	
DEPTH IN FEET SAMPLER	DESCRIPTION		BLOWS per FOOT (N)	ES		_	l bev		TION RE			
DEPTH IN FEET SAMPLER	OF		S TO	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		10	20 30 	40	60	80 10
SAI LITI	MATERIAL		BL.	CON	۱,	PLA:						
- 35 - 35 - 40 - 45 - 50 - 55 - 55 - 60	(continued) SAND(SM), fine-grained, silty loose to dense, bluish gray  slightly clayey @53' few shells @ 55'		10 11 11 9 12									

			so	IL BOR	EHC	LE	LC	OG							
SITE	NAN	IE AN	D LOCATION: F-22 Beddown Facility	DRILLING ME		nud 8 fe	rotar et, us	y wit sed a	h tricon about 1	e bit /3 bag	ВО	RING I	NUME U-3	3ER	
			Langley Air Force Base	of QuickG		C-1:4	C	o= 0		<del></del>	<u> </u>	age (			
1			Hampton, Virginia	SAMPLING M		<u></u>						DRILL		<del></del>	
BOR	ING L	_OCA	TION:	with 2 turn	15 01 10	ipe 0	ii üit	z Call	neau	<del></del>	SI	ART		INIS	H
1				WATER LEV	EL_	6.0					T	ME	1	TIME	=
PRO	JECT	NUM	BER: 00-062	TIME		12:3	0				12	::00		1:30	)
				DATE		1/18/0	)1				1	ATE		DAT	
		T MS		CASING DE							1/1	8/01	1.	/18/	/01
DRIL	L RIC	3: <u>C</u> N	<u>90</u> 0						grass R: Fishb		\rillin	a lac		—	
SAMI	L AN	GLE: IAMM	ER TYPE: 140# safety hamme	er	LOGGE					ourne L	71 1111[]	y, inc	<u></u>		
				· •			RES			PENETR	ATION	RESIS	TANC	Œ	
DEPTH IN FEET	LER	LITHOLOGY	DESCRIPTION		BLOWS per FOOT (N)	χ⊢ *	% ۵	È		10		30 40			0 100
<b> </b>	SAMPLER	본	OF MATERIAL		\$8	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		Ť	Ť		П	TĪ	$\prod$
	ြတ်	<u>  5</u>	INICITAL		<u> </u>	- 8		<u>g</u> .					$\coprod$	Щ	
- - -			(continued_ SAND(SM), fine-grained, silty loose to dense, bluish gray		20										
F-65	<u> </u>	<del>-</del>	Bottom of Boring @ 65'												
- -70 -	i.														
- - -75											:				
<u> -</u>															
- 80 - - -		  -  -				:			i						
- -85 -							: :								
[ -90 -		-													

			so	IL BOR	EH	OLE	ELC	)G					
SITE	NAM	ĺ	LOCATION: F-22 Beddown Facility	DRILLING ME started dri of QuickG	lling (	mud ) 8 fe	rotar et, us	y wit sed a	h tricone bit about 1/4 bag	BORING	3 NL MU-		:R
			Langley Air Force Base Hampton, Virginia	SAMPLING MI		: Spli	t Spo	on S	ampler	pag	je 1	of 2	
			• •	with 2 turr						DR	LLIN	G	
BOR	NG L	OCATI	ON:				. 1			START	-		IISH
2001	FOT	NUMB	er: 00-062	WATER LEV	EL	6.0 10:3				TIME 10:15	;		ме :50
PROJ	ECI	NUMB	ER: 00-002	DATE		1/18				DATE	+	D	ATE
DATU	M: F1	MSL	GROUND ELE.: 5.96 ft	CASING DE	PTH					1/18/0	1	1/1	8/01
		: CM							3" AC over			<u>e</u>	
DRILL									R: Fishburne [	Orilling, I	nc.		
	LE HA		R TYPE: 140# safety hamme			lee6	′: M. T RES			ATION RE	SIST	ANCE	<u></u>
DEPTH IN FEET	ER	тногосу	DESCRIPTION		BLOWS per	2 ×	,		10	20 30 4			80 100
EPT FE	SAMPLER	로	OF MATERIAL		NO.	WATER CONTENT %	LIQUID	PLASTICITY INDEX		70 00 -	Ĭ	ŤΤ	
۵	SA	5	IVIATERIAL		ਕ '	- 8		7_					
- - - - - - - - - - - - - - - - - - -			CLAY (CL), very sandy, stiff to stiff, few rounded mottled yellow and brown SAND (SM), very fine-gravery loose to loose, mott and gray  SAND(SM), very fine-gravery loose to loose, bluis	pebbles,  ained, silty, led orange	m 5 11 9 3 3 6 6 6								
-25 - - - -30 -					g								

			SO	L BOR	EH	0	LE	LC	G			_				
SITE	NAM		LOCATION: F-22 Beddown Facility	DRILLING ME started dri		D: m @ 8	ud r 3 fee	otary et, us	wit ed a	h tricon about 1.	e bit /3 bag	ВО	RING AN	NU -UN		R
			Langley Air Force Base	of QuickG			N = 1:4	0	0			┝┈			4.0	
		ļ	Hampton, Virginia	SAMPLING MI							-	<del>                                     </del>	age			<del></del>
BORII	NG L	OCAT	ION:	with 2 turr	1S OI	тор	e or	ı tne	cat	nead		19	ART	LING		ISH
				WATER LEV	EL	T	6.0	1			1		ME	十		/IE
PROJ	ECT	NUMB	er: 00-062	TIME			0:30	5				10	:15		10	:50
				DATE		1,	/18/0	1					ATE	十		ATE
DATU	M: F1	MSL	GROUND ELE.: 5.96 ft	CASING DE								<u> </u>	8/01			8/01
DRILL								NDIT			over				)	
DRILL				<u>.</u>						R: Fishb	ourne l	Orillin	g, In	C.		
	LE HA		R TYPE: 140# safety hamme					M. T	_		PENETR	ATION	DEC	ICT A	NCE	
DEPTH IN FEET	ER	LITHOLOGY	DESCRIPTION		) per	≀⊊⊩		• 1		'						
EE H	SAMPLER	호	OF		Š	힑	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		10 I	20 	30 40 1 T	T	60 	80 10
۵	SAN	Ė	MATERIAL		B	띰	ŠŠ		PLAS							
						T	Ī	•			T	Ť		T		
_			SAND(SM), very fine-gra													
_			very loose to loose, bluis	sh gray							$\parallel$					
_ [					1	ا ما	-				¥					
- 35					`											1
			Bottom of Boring @ 35'													
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			SO	IL BOR	Ε	HO	LE	L	)G	-			<b>V</b> 14		<u>-</u> .			
SITE	NAM	1	LOCATION: F-22 Beddown Facility	DRILLING ME started dri of QuickG	llin	OD: n	nud 8 fe	rotar et, u	y wit sed a	h tricor about 1	e bit /4 ba		BOR	ING AMI			R	
			Langley Air Force Base Hampton, Virginia	SAMPLING MI		HOD:	Split	Spo	on S	ampler			pa	age	1 01	f 2		
			• , ,	with 2 turn							•••		- 1	DRIŁI	JNG	)		$\neg$
BORI	NG L	OCAT	ION:										STA		Ţ	FIN		$\Box$
PROJ	ECT	NUMB	er: 00-062	WATER LEV	EL		5.0 1:00						11. 12:	45			15	
DATU	M·F3	MSI	GROUND ELE.: 5.15 ft	DATE CASING DE			1/17/	01			-	_	DA <sup>2</sup>				TE 7/0	1
_		: CM		CASING DE	_	1	CE C	TIDNC	PIONS	1/25"	AC	over			ret		110	-
DRILL										R: Fisht						<u> </u>		٦
			R TYPE: 140# safety hamme	r				М.					9	, ,,,,,	•			_
						ž ć		RES	ULTS	1	PENE	TRAT	10N I	RESIS	STAI	NCE		_
DEPTH IN FEET	'LEF	١٥	DESCRIPTION OF			VS P	ER NT%	5%	ĮĘ,×		1	0 2	20 30	40	6	30	80 1	oq
99 130	SAMPLER	лтного в	MATERIAL			BLOWS per FOOT (N)	WATER CONTENT %	LIMIT %	PLASTICITY INDEX									
			8.25" AC and concrete			8					,							Ī
	<del>                                     </del>		SAND(SP)															
-			SAND(SC)			4					•							
- - 5			J 12 (33)			2	34											
			Percent finer than No. 20	00 = 23.5%	ı	3	34											
 -	-	<b>-</b>	SAND(SM), v. fine-grain	 ed siltv ve	 rv	3												
—10 -			loose to loose, bluish gra		.,													
- - -			Percent finer than No. 20	nn = 14 9%		5	36			$  \  $								
<del>-</del> 15										1								
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- -20			trace shell fragments			6												
			•															
− −25						9												
-																		
٠. ا ۸۸						9					}							
- 30 - -																		

			SO	IL BOR	ΕH	10	LE	LC	G				•				7
SITE	NAMI	1	LOCATION: F-22 Beddown Facility	DRILLING ME started dri of QuickG	lling	D: nr @	nud r 8 fee	otarş et, us	/ wit sed a	h tricon about 1	e bit /3 bag	BOR	ING N			₹	1
Ì			Langley Air Force Base Hampton, Virginia	SAMPLING MI		D: \$	Split	Spoo	on S	ampler		pa	age 2	2 of	2		٦
			. , •	with 2 turr									DRILL	ING			
BORII	NG L	OCAT	ION:				<u> </u>	1				STA	ART ME	+	FINI		4
DBO I	ECT I		ser: 00-062	WATER LEV TIME	<u>EL</u>	$\neg$	<u>5.0</u> 1:00	+		<u>-</u>		12:		1	⊤ім 1:1:		١
PROJ	EUI	NUMB	SER. 00-002	DATE			/17/0	1				DA	TE	T	DA	TE	┪
DATU	M: FT	MSL	GROUND ELE.: 5.15 ft	CASING DE	PTH	_							7/01	↓—		7/01	╛
DRILL				· · · · · · · · · · · · · · · · · · ·			CE CC				AC ov				<u> </u>		4
DRILL			R TYPE: 140# safety hamme	<u> </u>			G CO D BY:			R: Fisht	ourne D	rilling	<u>, inc</u>				$\dashv$
			-		$\overline{}$	- 1	TEST				PENETRA	TION	RESIS	TAN	CE		┪
DEPTH IN FEET	LER	FOG	DESCRIPTION OF		/S pg	2 Z	#F	<u>₽</u> %	À,		10	20 3	0 40	60	) E	30 10	pc
DEP	SAMPLER	LITHOLOGY	MATERIAL		S S	FOOT (N)	WATER CONTENT %	LIMIT %	PLASTICITY INDEX								
			(continued) SAND(SM), silty, very loose to loose, few shell fragments @34  Bottom of Boring @ 35'	bluish gray	/	12											
<del>-60</del> -			Bottom of Boring @ 60'														

			SO	IL BOR	EHC	LE	L	OG				<del></del> .	·		
SITE	NAME	ı	LOCATION: F-22 Beddown Facility	DRILLING ME started drii of QuickG	ling @	nud 8 fe	rotar et, us	y wit	h tricone about 1/4	bit 4 bag		RING AN	NUI IU-E		R
			Langley Air Force Base Hampton, Virginia	SAMPLING ME		Split	Spo	on S	ampler			page	10	of 3	
		•	riampion, ingina	with 2 turr							<del>                                     </del>	DRIL			
BORI	NG L	OCAT	ION:									ART		FIN	SH
			00.000	WATER LEVI	EL	7.0					i	IME :20		TIN 11:	
PROJ	IECT I	NUMB	BER: 00-062	TIME DATE		10:0						ATE			TE
DATU	M: FT	MSL	GROUND ELE.: 5.15 ft	CASING DE	PTH	1/17/	01					17/01	ı		7/01
DRIL	L RIG	: CM	E		SURFA	CE C	DNDIT	IONS	1.5" A	C ov	er 6"	conc	rete	<del></del>	
DRILL	. ANG	LE:	900		DRILLII	NG CC	NTRA	СТО	રઃ Fishbા						
SAMP	LE H	AMME	R TYPE: 140# safety hamme	r	LOGGE										
<u>z</u> _	ہے	)GY	DESCRIPTION		ğ.	TEST	RES		PI	ENETR					
DEPTH IN FEET	SAMPLER	-тногосу	OF		BLOWS per FOOT (N)	WATER CONTENT 9	LIMIT %	PLASTICITY INDEX		10	20	30 40	)	60 	80 100 TTT
DE	SAN	Ħ	MATERIAL		F	<sup>≥</sup> S	75	PLAS							
						Ī					十	$\overline{\Box}$	$\overline{\top}$	$\overline{\Box}$	
_			SAND (SC), fine grained loose, mottled yellow, br		9										
_ 			gray	OWII allu	8	12				II					
_			3'-7							1					
<b>-</b> 5			B 15 11 11 0	00 40 004	9	24	,			7					
			Percent finer than No. 2	00 = 19.8%	7	29			,	/					
<del>-</del>															
	1-				- 2	33									
10			SAND (SM), very fine-gr												
_			loose to medium dense,	bluish gray											
_			Percent finer than No. 20	00 = 18.3%					\						
-					8	33				$\setminus \setminus$					
<del></del> 15	$\vdash$									1					
							i i			$\left\{ \right. \right\}$					
L					8	36							-1		
-20	$\vdash$									$\backslash \rfloor$					
-			,												
	<u></u>									\					
<b> </b> -			few shell fragments star	ting @ 24'	10	33				Ĭ					
<b>—25</b>	$\vdash$		10 W SHOII Hagillollis Stall	y @ 27											
Į_															
					11	32				\					
- 30	Щ.	-													
-															
-	1		<u> </u>	•			<u> </u>		<u> </u>	1_		لـــــــــــــــــــــــــــــــــــــ	Ļ_	$\perp$	<u>i li</u>

F-22 Beddown Facility Langley Air Force Base Hampton, Virginia  BORING LOCATION:  WATER LE PROJECT NUMBER: 00-062  DATUM: FT MSL  DATUM: FT MSL  DRILL RIG: CME DRILL ANGLE: 900  SAMPLE HAMMER TYPE: 140# safety hammer  NET LANGLE: 900  SAMPLE HAMMER TYPE: 140# safety hammer  OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium denibluish gray  few shell fragments	ETHOC ns of EL SURI DRIL LOG	TESPI TOPE 7.0 1/17 1/17 FACE (N) SED B TESPI MAYER	t Spo on the 00 /01 ONTR/ CONDIT	on Se cati	ampler nead 1.5" / R: Fisht		ST. TI 9: DA 1/1 r 6" C	g, Inc	2 of ING	FINI TIM 11: DA 1/17	ISH ME
Hampton, Virginia  BORING LOCATION:  PROJECT NUMBER: 00-062  DATUM: FT MSL  DATUM: FT MSL  DRILL RIG: CME  DRILL ANGLE: 900  SAMPLE HAMMER TYPE: 140# safety hammer  PESCRIPTION  OF  MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium den bluish gray  few shell fragments	EL PTH SURI DRIL LOGI SMOJB	TES (N) LOOJ 1/17	OO /O1 CONDIT ONTRA	TIONS ACTOI Thon	1.5" /	AC ove	ST. TI 9: DA 1/1 r 6" c	DRILL ART ME 20 ATE 7/01 concre g, Inc	ete	FINI TIM 11: DA 1/17	1E 00 TE 7/01
BORING LOCATION:  PROJECT NUMBER: 00-062  DATUM: FT MSL GROUND ELE.: 5.15 ft CASING DESCRIPTION OF MATERIAL  NI LANGLE: 90°  SAMPLE HAMMER TYPE: 140# safety hammer  OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium denibluish gray  few shell fragments	EL  PTH SURI DRIL LOG	TES (N) LOOJ 1/17	OO /O1 CONDIT ONTRA	TIONS ACTOI Thon	1.5" /	AC ove	ST. TI 9: DA 1/1 r 6" c	DRILL ART ME 20 ATE 7/01 concre g, Inc	ete	FINI TIM 11: DA 1/17	1E 00 TE 7/01
PROJECT NUMBER: 00-062  TIME DATUM: FT MSL  DRILL RIG: CME  DRILL ANGLE: 90°  SAMPLE HAMMER TYPE: 140# safety hammer  PROJECT NUMBER: 00-062  DRILL RIG: CME  DRILL ANGLE: 90°  SAMPLE HAMMER TYPE: 140# safety hammer  OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium denibluish gray  few shell fragments	EL SURI DRIL LOG LOGS e,	7.0 10: 1/17 FACE (N) LING COED B	OO //O1 //ONDIT ONTRA	TIONS ACTOR Thon ULTS	1.5" / R: Fisht	Durne C	DA 1/1 r 6" c	ART ME 20 ATE 7/01 concre g, Inc	ete	TIM 11: DA 1/17	1E 00 TE 7/01
PROJECT NUMBER: 00-062  DATUM: FT MSL GROUND ELE.:5.15 ft CASING DATE  DRILL RIG: CME  DRILL ANGLE: 900  SAMPLE HAMMER TYPE: 140# safety hammer  PROJECT NUMBER: 00-062  DRILL RIG: CME  DRILL ANGLE: 900  SAMPLE HAMMER TYPE: 140# safety hammer  OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium denibluish gray  few shell fragments	DRIL LOG SMOJB	10: 1/17 ACE (N) LOOL ING C GED B TES	OODITONTRA	ACTOI Thon ULTS	R: Fisht nas	Durne C	DA 1/1 r 6" c	ME 20 ATE 7/01 concre g, Inc	ete	TIM 11: DA 1/17	1E 00 TE 7/01
PROJECT NUMBER: 00-062  DATUM: FT MSL GROUND ELE.:5.15 ft CASING DATUM: FT MSL GROUND ELE.:5.15 ft MSL GROU	DRIL LOG SMOJB	10: 1/17 ACE (N) LOOL ING C GED B TES	OODITONTRA	ACTOI Thon ULTS	R: Fisht nas	Durne C	1/1 1/1 r 6" c Drilling	TE 7/01 concre g, Inc	ete	DA 1/17	7/01
DATUM: FT MSL GROUND ELE.: 5, 15 ft CASING DESCRIPTION OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium denibluish gray few shell fragments	SURI DRIL LOG Jed SMO78	TES (N) LOOJ (N) LOOJ (N) LOOJ (N) MATER (N) M	ONDITONTRA	ACTOI Thon ULTS	R: Fisht nas	Durne C	1/1 r 6" c Drilling	7/01 concre g, Inc	ete STAN	1/17	7/01
DRILL RIG: CME  DRILL ANGLE: 90°  SAMPLE HAMMER TYPE: 140# safety hammer  DESCRIPTION OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium den- bluish gray few shell fragments	SURI DRIL LOG Jed SMO78	WATER TENTER CONTINUE	ONTRA	ACTOI Thon ULTS	R: Fisht nas	Durne C	r 6" c Prilling	oncre g, Inc	ete STAN	ICE	
DRILL ANGLE: 90°  SAMPLE HAMMER TYPE: 140# safety hammer  DESCRIPTION OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium den- bluish gray few shell fragments	DRIL LOG Jack SMO78	WATER TENTER CONTINUE	ONTRA	ACTOI Thon ULTS	R: Fisht nas	Durne C	Orilling ATION	g, Inc	STAN		80 10
SAMPLE HAMMER TYPE: 140# safety hammer  DESCRIPTION OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium den bluish gray few shell fragments	e,	FOOT (N) WATER WATER	T RES % LIMIT	Thon ULTS	nas	PENETR/	ATION	RESIS	STAN		80 10
DESCRIPTION OF MATERIAL  (continued) SAND(SM), very fine grained, silty loose to medium den bluish gray few shell fragments	e,	WATER THE SONTENT WATER	T RES % LIWIT GIRDIT	ULTS							80 10
(continued) SAND(SM), very fine grained, silty loose to medium den bluish gray  few shell fragments	е,	FOOT (N)	% בושוז מוחסוז								80 1C
(continued) SAND(SM), very fine grained, silty loose to medium den bluish gray  few shell fragments	е,			PLASTICITY INDEX		10	20 3	30 40	6	50	80 10
(continued) SAND(SM), very fine grained, silty loose to medium den bluish gray  few shell fragments	е,			PLAS							
grained, silty loose to medium den bluish gray  few shell fragments	- 1	1 32									
-40 - - - - - - - - - - - - - - - - - -	1 1 1	37									

			SO	IL BOR	EH	10	LE	LC	OG		•						
SITE N	AME		LOCATION: F-22 Beddown Facility	DRILLING ME		): n @	nud r 8 fee	otary et, us	y wit	h tricon about 1	e bit /3 bag	ВОІ	RING	NU MU		ER	-
1			Langley Air Force Base	of QuickG		n. (	2 m lid 1	C n o	C	lar	· -	╀-,	age	3 /			
			Hampton, Virginia	SAMPLING MI with 2 turr								<del>                                     </del>	DRIL			-	
BORING	G LC	CAT	ION:	With Z turn	15 01	101	JE U	i uic	Cau	leau		ST	ART			NISF	$\dashv$
				WATER LEV	EL		7.0					TI	ME	$\top$	TI	ME	
PROJE	CT I	NUMB	er: 00-062	TIME			10:00	$\overline{}$				9:	20			:00	
- 4 - 1 100				DATE		1	/17/0	1		_			ATE 7/01			ATE	- 1
DATUM			0.10 It	CASING DE			NE 00	LIDIT.	10110	4 511 4						17/	JT
DRILL I	RIG: Ang	UN LE:	900							<u>1.5" A</u> R: Fishb					<u>:</u>		
SAMPLE	E HA	MME	R TYPE: 140# safety hamme	r			D BY:				- 41110 1	. (1)(1)	<u>ي</u> , ۱۱۱	. <del></del>			
7							TEST				PENETR	ATION	RES	IST	ANCI	Ē	
DEPTH IN FEET	SAMPLER	LITHOLOGY	DESCRIPTION OF		VS p	FOOT (N)	쌇	5 %	ΣĽ		10	20	30 40	0	60	80	100
DEP	AMF	THC	MATERIAL		o Z	S S	WATER CONTENT %	LIMIT %	PLASTICITY INDEX								$\prod$
'	တ						3		Δ				Щ		<u> </u>	Ц	<u> </u>
- - - - - - - -			(continued) SAND(SM), grained, silty, loose to m bluish gray			17	36.										
-70 -70 -75 -75 -80 -85 -85	And a state of the		Bottom of Boring @ 65'														

			SO	IL BOR	ΕH	Ol	LE	LC	)G									
SITE	NAME	E AND	LOCATION:	DRILLING ME	THOD	): co	ntin	LLOUS	s flia	ht aug	er	E	3OR	ING	NUI	ИВE	R	
ı			F-22 Beddown Facility									_		АМ	U-7	7		
•			Langley Air Force Base	544511164			\ l-				-	_						
			Hampton, Virginia	SAMPLING MI	ETHUL	D: G	rab					+		DRILL	INIC			
BORII	NG L	OCAT	ION:		-							+	STA		INC		IISH	
				WATER LEV	EL	n	ot e	ncou	inte	ed	Γ	$\dashv$	TIN		+		ME	┪
PROJ	ECT I	NUMB	BER: 00-062	TIME			<del></del>		1110	<u> </u>			2:	30		2:	45	
				DATE									DA	ΤE			ATE	
DATU	M: FT	MSL	GROUND ELE.: 5.10 ft	CASING DE	PTH								1/17			1/1		
DRILL	RIG	CM	<u>E</u>					NDIT			nches					con	сге	te
DRILL										R: Fishl	burne	Dril	ling	, Inc	; <u> </u>			
	LE H/		R TYPE: 140# safety hamme	r		1_		M. T			PENET		ONI	2501	-T A	NOF		
DEPTH IN FEET	H.	LITHOLOGY	DESCRIPTION		) per	-												
FE	SAMPLER	φ.	OF		- Is	ğ	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		10 I	) 20	) 30 I	) 40 T	T	60 T T	80	100
DE	SA	LIT	MATERIAL			띡	ŠŠ		PLAS									
			Asphalt Surface (1.25 inch 7 inches of concrete Clay (CL) very sandy, silty, pebbles brown and collected bulk sample from Bottom of Boring @ 5'  maximim dry density = 1 optimum moisture conte CBR @ 0.1" = 11.0 CBR @ 0.2" = 12.8	with small gray m 1 to 5'														
30											ļ							

			SO	IL BOR	Eŀ	10	LE	LC	G									
SITE	NAME	AND	LOCATION:	DRILLING ME	THC	D: CC	ontir	uous	fligh	nt auge	er .	E	BORI	NG	NUI	ИВE	ER.	一
I		ļ	F-22 Beddown Facility									$\dashv$		ΑM	U-8	3		
			Langley Air Force Base	SAMPLING MI	 ETU/	OD: C					<u> </u>	一						$\dashv$
		i	Hampton, Virginia	DAMELING MI	- 1 171	J. C	יומט	<u> </u>				+	Г	RILI	INC		—	$\dashv$
BORI	NG LO	CATI	ON:									+	STA		Τ		VISH	
				WATER LEV	EL	h	ot e	ndoui	nter	ed			TIM	E	T	TI	ΜE	$\neg$
PROJ	ECT I	NUMB	ER: 00-062	TIME							<u> </u>	$\perp$		50	$\bot$		:00	
			GROUND ELE.: 6.10 ft	DATE		_		<del> </del>	_			┦,	DAT				7/0	
DATU				CASING DE	_			NDITI	ONE	4.0 inc	hes A		1/17	/U I		17 1		$\dashv$
DRILL DRILL	RIG:	LE	900	••						Fisht			lina.	Inc	— :			_
			R TYPE: 140# safety hamme					M. T										
						ž Č		RESU	JLTS	ļ	PENET	RATI	ON F	RESI	STA	NCE	=	
DEPTH IN FEET	SAMPLER	LITHOLOGY	DESCRIPTION OF			BLOWS per FOOT (N)	WATER CONTENT %	OF %	E <sub>X</sub>		10	) 20	30	40		60	80	100
OEP H	AMP	FE	MATERIAL		İ	2 5 5	WAT	LIQUID LIMIT %	PLASTICITY INDEX									
	S						٦		<u> </u>					<u> </u>	÷	₩	ᆣ	₩
L.			Asphalt Surface (4.0 inche	s asphalt)														
-			Clay (CL) very sandy, silty,	brown					l									
			and gray															
			collected bulk sample from	om 1 to 5'								}						
, ,			Bottom of Boring @ 5'		1													
1											ŀ							
Ĺ											i							
-10			maximim dry density = 1	19 ncf							ŀ							
-			optimum moisture conte															
+			CBR @ 0.1" = 4.2															Ш
<b> </b>			CBR @ 0.2" = 3.8															Ш
15														ł				
<b>F</b> "																		
t																		
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L <sub>20</sub>	1																	
<b>F</b> -~																		
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<b>-</b> 30																		
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L.	1												l		$oldsymbol{\perp}$	$\perp$		$\perp \perp$

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			so	IL BOR	EHO	OLE	ELC	OG			_	<del></del>	
SITE	NAMI	1	LOCATION: F-22 Beddown Facility	DRILLING ME started dril of QuickG	lling @	mud ) 8 fe	rotar et, u	y wit sed	h tricone bit about 1/4 bag	BORING AMI		MBE	R
1			Langley Air Force Base Hampton, Virginia	SAMPLING MI		Spli	Spc	on S	Sampler	page	e 1 c	of 2	
			nampton, virginia	with 2 turr						DRIL			
BORI	NG L	OCATI	ION:		<u>; -, -, .</u>	<u>-                                    </u>				START	T	FIN	IISH
				WATER LEV	EL	7.5				TIME	$\top$		ME
PROJ	ECT	NU <b>M</b> B	ER: 00-062	TIME		11:1				11:00			:45
DATU	M. CT	Mei	GROUND ELE.: 7.44 ft	DATE		1/18/	01			DATE 1/18/01	.		ATE 8/01
DATU				CASING DE					2" 40	1/10/0	<u> </u>	1/ 1	0/01
DRILL		: CM				ACE C				Deilling In		—	
			R TYPE: 140# safety hamme	-		ED BY			R: Fishburne [	Juling, in	C.	—	
			KTTTE. 140# Salety Hamme				T RES		<del></del>	ATION RES	ISTA	NCE	
DEPTH IN FEET	ER	г <u>т</u> но <u>г</u> осу	DESCRIPTION		BLOWS per	3		$\overline{}$	10	20 30 40			80 100
EPT FEE	SAMPLER	로	OF MATERIAL		M	WATER CONTENT %	LIGUID	PLASTICITY INDEX	10	20 30 40	<u>,</u>	ŤΤ	
۵	δA	LiT	MATERIAL		굨,	<b>-</b>   ⁵ 8		¥ <sup>±</sup>					
- - - -5 - - -10			SAND(SM), v. fine-grained dense, pieces of brick in sa CLAY (CL), very sandy, silt rounded pebbles, stiff, mot Percent finer than No. 200 SAND(SM), silty, clayey, lowellow and gray  SAND(SM), very fine-gray very loose to loose, bluis Percent finer than No. 200	mple, gray ( y with few tled yellow = 56.1%   ose, mottled   ained, silty,   sh gray	13	20	40	21			LAMA ASSESSION PROPERTY.		
- - -15			Percent finer than No.20	00 = 15%	6	33							
- -20 -			Shelby Tube Sample 18- 28" of recovery	20'		34							
- -25 -			Shelby Tube Sample 23 30" of recovery	-25'		33							
- 30 -				·	10	34							

	SO	IL BOR	EHC	LE	LC	OG								7
	F-22 Beddown Facility	DRILLING ME started dri of QuickG		nud r 8 fee	otan et, us	y wit sed a	h tricon about 1	e bit /3 bag	BOI	RING N		BEF	₹	
	Langley Air Force Base Hampton, Virginia	SAMPLING M		Split	Spo	on S	ampler		t	age 2	of:	 2		
	, , ,	with 2 turi								DRILL	ING			
BORING LOCAT	TION:	MATER LEV	<u>-                                    </u>	7.5	<del></del>			I		ART ME	+	TIMIS		4
PROJECT NUME	BER: 00-062	WATER LEV	EL	7.5 11:1:	5					:00		11:4	_	
		DATE		1/18/0						ATE	Τ.	DA		
DATUM: FT MSL		CASING DE					211 4.0	<u> </u>	1/1	8/01	1	/18	3/01	<u> </u>
DRILL RIG: CM DRILL ANGLE:			SURFA				3" AC F: Fisht		Drillin	a Inc				$\dashv$
	ER TYPE: 140# safety hamme	r	LOGGE					Juine		y, 1110	•			┪
	_							PENET	RATION	RESIS	TAN	CE		٦
DEPTH IN FEET SAMPLER	DESCRIPTION OF		BLOWS per FOOT (N)	WATER CONTENT %	LIQUID	Ϋ́C		10	20	30 40	60	8 (	30 1	00
DEF SAMI	MATERIAL		BLO	CONTE	Z E	PLASTICITY INDEX								
- 35 - 35 - 40 - 45 50 55 60	(continued) SAND(SM), fine-grained, silty, very lo loose, bluish gray  Bottom of Boring @ 35'		10	54										

			SO	IL BOR	EHO	)LE	L(	OG					
SITE	NAME	 	LOCATION: F-22 Beddown Facility Langley Air Force Base	DRILLING ME started dril of QuickG SAMPLING ME	ling @ el	) 8 fe	et, u	sed a	h tricone bit about 1/4 bag	BORING	NUN O-1	/BEF	₹
		į	Hampton, Virginia						· · · · · · · · · · · · · · · · · · ·	50"	LING		
BORII	NG L	)CAT	ION·	with	2 turr	s of r	ope	on th	ne cathead	<del> </del>	LING		011
DO:\(i,		JUA 11	ion.	IA/ATED LEV		8.0			T	START TIME	+	FINI	
			00 000	WATER LEVI	<u> </u>	12:4	-+ $-$			12:30		13:2	
PROJ	ECT	NUMB	ER: 00-062	DATE			<del></del>			DATE		DA	
DATU	M· FT	Mei	GROUND ELE.: 6.42 ft	CASING DE	DTH	1/10/	01			1/10/01		1/10	
				CASING DE		1		TIONIO	grass	17 1070	<u> </u>		
DRILL					SURF				grass R: Fishburne (	Drilling In			
DRILL				<u> </u>	LOGG					Jiming, in	<u>u.</u>		
	LE H/		R TYPE: 140# safety hamme	ı			· IVI. ΓRES			ATION RES	ICTA:	NCE.	
DEPTH IN FEET	照	ģ	DESCRIPTION		je 2	1 2		T .					
두표	PE	9	OF OF		WS	Z E E	LIQUID LIMIT %	5 <sup>±</sup>	10	20 30 40	1	50 E	30 10
Ä"	SAMPLER	LITHOLOGY	MATERIAL		BLOWS per	WATER CONTENT %	=====================================	PLASTICITY INDEX					
	<u>"</u>				+	1	1				$\pm$		
. [		- 1	SAND(SC), very fine-graine		12	13	38	19	l \				
·			medium dense, dark yellow						'	$\setminus \mid \cdot \mid \cdot \mid$			
			Percent finer than No. 200	= 36.9% 	_	•				$\backslash        $			
			SAND(SC), very fine-grained.		lium					<b>V</b>			
- 5			dense, mottled yellow, brown Percent finer than No. 200 = 3		22	13	63	36		<i>-</i> }			
.			SAND (SC), fine grained, clayey			1							
	_ _	:	brown and red with trace angula	grave	. 3								
-10			SAND (SM), very fine-grain little shell fragments, loose dense, dark blue gray										
-15 -			Percent finer than No. 200	= 9.5%	9	32							
- - - -20					16		į						
- - - - -25					15								
- - - 30					15	5							
- 30 - -			Bottom of Boring @ 3	30'									

			SO	IL BOR	EHC	LE	LC	)G							
SITE	NAME		LOCATION: F-22 Beddown Facility	DRILLING ME started drii of QuickG	ling @	nud i 8 fee	otarı et, us	wit sed a	h tricon about 1	e bit /3 baç		RING	NUI D-2	иве	₹
			Langley Air Force Base	SAMPLING ME		Snlit	Sno	on S	ampler		_	page	1 0	f 2	
			Hampton, Virginia	with 2 turn					<u>.</u>		-		LINC		
BOR	NG L	CAT	ION:	With Z turn	13 01 10	ре о	ii uic	Cat	ileau		s	TART		FINI	SH
				WATER LEV	EL	5.0						ГІМЕ		TIM	
PRO.	JECT I	NUME	er: 00-062	TIME		11:00	)				1	0:50		12:	15
			450 %	DATE		1/10/0	1					ATE	.		TE
	M: FT			CASING DE						<u> </u>	1 1/	10/01	!	1/10	0/01
	L RIG:				SURFA						Deillie				
	L ANG		R TYPE: 140# safety hamme	<b>-</b>	LOGGE				R: Fisht	urne	Drillir	ng, in	C.		
	LE HA		R TTPE: 140# Salety Hamilie			r				PENET	RATIO	N RES	ISTA	NCE	
DEPTH IN FEET	띪	LITHOLOGY	DESCRIPTION		S pe	WATER CONTENT %						30 4			80 100
EPTI FEE	SAMPLER	HOL	OF		OW.	ATER	LIQUID	PLASTICITY INDEX		10	7	7			
莅	₹	LITI	MATERIAL		<u> </u>	≥ 0		길							
_			CLAY (CL), silty with little fir	ne sand.	11	24									
-			stiff to very stiff, dark yellow		' '						$\bigvee$				
-				(fill)	22	18	:				$\mathcal{A}$				
	<del>                                     </del>		SAND (SC), fine grained, clayey, i		-										111
5	┨═┋		brown SAND (SM),v. fine-gr., silty,	v loose	_ 10	35				1					
			petroleum odor, dark gray	v. 10056,	_ 3	37									
	Ħ		SAND (SM), fine gr., slity, loos	e areen ara						1					
<b>-</b>	┨═┠╴┪		(ON), line gr., sity, loos		6	34		•	Ì	\					
<b>—10</b>	П		SAND (SM), very fine grain							1					111
_			loose to medium dense, blu	isn gray						1					111
_	Щ									11					
-					8	33				$ \cdot $					
<b>—15</b>	ш		few shell fragments							$\setminus$					
L.			<i>.</i>							I					
										- 1	$\setminus \bot$				
					17	29					$\backslash \bot$				
-20	$\coprod$		Percent finer than No. 200	= 12.6%	''										
											1				
<b>-</b>					ļ										111
Ė					40	20					\				
- -25					19	29				1					
F											ı				
L	-	}									I				
1					20	29				]					
<del>-</del> 30		1													
Γ	1				-			1	1	1					

•	SOI	L BOR	ЕНО	LE	LC	G			-		
SITE NAME AND LOCATION: F-22 Beddown		DRILLING ME started dril of QuickGo	ling @	nud r 8 fee	otary et, us	wit ed a	h tricone bit about 1/3 bag		NG NU		R
Langley Air Fo Hampton, Virgi		SAMPLING ME		Split	Spoo	on S	ampler	pa	ge 2	of 2	
riampton, viigi	iiiiQ	with 2 turr							RILLIN		-
BORING LOCATION:								STA		FIN	IISH
		WATER LEVI		5.0	-			10:			ME ∷15
PROJECT NUMBER: 00-062		TIME		<u>11:0</u>				DAT			ATE
DATUM: FT MSL GROUN	D ELE.: 4.52 ft	CASING DE		1/10/0	21			1/10			0/01
DRILL RIG: CME		· · · · · · · · · · · · · · · · · · ·		CE CC	NDIT	ONS	grass	<u> </u>			
DRILL ANGLE: 900							R: Fishburne	Drilling,	Inc.		
SAMPLE HAMMER TYPE: 140# s	safety hammer		LOGGE								
Z	ESCRIPTION		S per		RESU		PENET	RATION F			
	OF		BLOWS per FOOT (N)	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX	10	20 30	40 T	60	80 100
SAN LITH	MATERIAL		BLC FG	CON	55	PLAS					
grained, silt dense, bluis  Percent fin	SAND (SM), very, loose to ments of gray	dium	12 24 21	32 34 31							

SOI	L BOR	EHO	LE	LC	OG					
SITE NAME AND LOCATION: F-22 Beddown Facility	DRILLING ME started dril	ling @	nud i 8 fe	rotar et, u	y with sed a	n tricon about 1/	e bit 4 bag	BORING N LO-3		ĒR
Langley Air Force Base	of QuickG		O 1:4	0	0					
Hampton, Virginia	SAMPLING ME			<u> </u>		<u> </u>		DRILLI	ING	
BORING LOCATION:	with 2 turr	is of ro	pe o	n tne	cat	nead		START		NISH
	WATER LEVI	ĒL [	6.0					TIME	+	ME
PROJECT NUMBER: 00-062	TIME		14:2					14:10	14	1:45
TROUBLING SO SO =	DATE		1/10/0					DATE	D	ATE
DATUM: FT MSL GROUND ELE.: 5.68 ft	CASING DE							1/10/01	1/1	10/01
DRILL RIG: CME	_	SURFA	CE C	DNDIT	IONS	grass	<u> </u>			
DRILL ANGLE: 900							urne D	rilling, Inc.		
SAMPLE HAMMER TYPE: 140# safety hammer	r	LOGGE	<del>,</del>							
THE SECRIPTION		ğ g	IEST	KES	ULTS 1.	F	PENETRA	TION RESIS		
DESCRIPTION OF MATERIAL MATERIAL		WS OT (	TER &	LIQUID LIMIT %	Tio Tio Tio		10	20 30 40	60	80 10
SAMPLER SAMPLER OF MATERIAL MATERIAL		BLOWS per FOOT (N)	WATER CONTENT %	13	PLASTICITY INDEX					,
SAND (SC), very fine grained, cla	vev medium		40							
dense with roots, mottled yellow, t	brown and gra	ay 10	13				N			
Percent finer than No. 200 = 32.5	%	17					\	$\setminus   \cdot   \cdot  $		
<b> - - </b>		-1								
- 5       SAND (SC), very fine-gra		у, 19						시		
medium dense, reddish t	orown	3								
<del></del>						\ <u>\</u>				
-       SAND (SM), very fine-gra	ained, silty,	10								
_ <sub>10</sub>   medium dense, bluish gr							\			
trace shell fragments							\			
-								$\setminus \mid \cdot \mid \cdot \mid$		
·   ·		21	32					<b>\</b>     <i> </i>		
Percent finer than No. 20	00 = 10.3%		52					$\mathbb{N}$		
-15   1   1   1   1   1   1   1   1   1										
_								$ \cdot $		
		İ						$\parallel \parallel \parallel \parallel \parallel$	11	
Percent finer than No. 2	00 – 10 3%	26	30					-1/1		
-20   Percent liner than No. 21	00 - 10.5%	'								[
<u> </u>										
L []] [		20				Ī				$ \  \  $
_25					1					
F								/		$ \  \  $
F								/		
		40	1					'		
[20] [1]		13								
Bottom of Boring @ 30'										
						<u> </u>				

			SO	L BOR							<u> </u>					_
SITE	NAME		LOCATION:	DRILLING ME started dril	THOD: 1	nud 8 fe	rotar et. u	y with sed a	h tricon about 1	e bit /4 bac		ORING		MBI	ΞR	
			F-22 Beddown Facility Langley Air Force Base	of QuickG							~		)-4			_
			Hampton, Virginia	SAMPLING ME	ETHOD:	Split	Spo	on S	ampler	•	1					
			, , , , , , , , , , , , , , , , , , ,	with 2 turr	ns of ro	pe o	n the	e catl	nead			DRI	LLIN	G		_
BORII	NG L	OCATI	ON:									START		FII	NISH	<u>-</u>
				WATER LEV	EL	5.0						TIME			ME	
PROJ	ECT I	NUMB	er: 00-062	TIME		9:50						9:40	_		):50	
			000000 F/F 5 05 A	DATE		1/10/	01					DATE /10/0	,		ATE	
DATUI				CASING DE		<u> </u>				<u> </u>	<u> </u>		<u>'</u>	1/	10/0	_
DRILL			<u> </u>	-					<u>grass</u> R: Fisht	)UEDO	Drilli	na Ir	10			—
DRILL			R TYPE: 140# safety hamme	r	LOGGI					Juille	וווווט	ng, ii	iC.			_
	//	. [	NTIFE 170# Saidly Hailille			1		ULTS		PENET	RATIC	N RES	SIST	ANCI		_
DEPTH IN FEET	FR	LITHOLOGY	DESCRIPTION		S be	WATER T			<u>'</u>	10		30 4			- 80	11
FPI	SAMPLER	호	OF		§ C	/ATER	LIQUID LIMIT %	PLASTICITY INDEX		<u>10</u>	- ZU	70 4	Ť			Ť
<u> </u>	SA	LITI	MATERIAL			<b>≥</b> 8		A S								
	$\overline{\Box}$				8 6	13				T				T		Ŧ
<u> </u>				SAND (SM), fine-grained, silty, loose, dark brown						/						
_			dark brown		5	22			,	/						
	-		CLAY (CL), v. sandy, silty, med	medium stiff, brown						$\setminus \mid$						
5	- <del> -</del>  -				7	NR				$\rangle \mid$						1
_			SAND (SC), very fine-gr	ained, claye	ey,	31				/						
_	Щ		dark yellow brown		5	ادا				1			$  \  $			
-			Percent finer than No. 20	nn = 12 5%	WO	39			<b>/</b>							
<b>–10</b>			i ercent imer man No. 20	JU - 12.U/0												
- 	 	<u> </u>	- dark gray		]											
_	<u> </u>	-	SAND(SM), v. fine-grain	ed silty log	ose				\							
-			bluish gray	ou, oney, loc	7	33										ĺ
<b>-</b> 15	╙		- ,													
			Percent finer than No. 2	00 = 10.0% 						1						١
		[			_1						$\setminus \mid$					
  -			SAND (SM), very fine-gi		, 16	28					$\rangle$					
-20	Щ		medium dense, bluish g	ray												
-																1
_											'					
Ė		1			10	33				Y						
	$\coprod$		4		''	33				Ì		ĺ				
L 23			trace shell fragments							ין						ļ
-											\					1
٠.	<del> </del>	-														ļ
ſ					13	33	1				`					ļ
-30-	┾┶	<del> </del>	Rottom of Bosing @ 20'											$\  \ $		
-	1	1	Bottom of Boring @ 30'				1									

			so	IL BOR	Εŀ	10	LE	LC	G									
SITE	NAME	E AND	LOCATION:	DRILLING ME	THC	D: cc	ntin	uous	fligh	nt auge	er	В	ORII	VG N	NUM	BEF	₹	1
•			F-22 Beddown Facility							<del></del>		_		LO-	5			
1		l	_angley Air Force Base	CAMBI DIG I		<u> </u>	\L					╀						1
		i	Hampton, Virginia	SAMPLING MI	= IH(	JU: (	orab					+		RILL	ING			4
BOR	NG LO	OCATI	ON:									+	STAF		<del></del>	FINI	SH	$\dashv$
		,,,,,	-	WATER LEV	EL	In	ot e	Jeon	ntel	ed	Ī	十	TIM		T	TIM	_	1
PROJ	ECT I	NUMB	ER: 00-062	TIME								1						
				DATE									DAT	E	T	DA	TE	
DATU	M: FT	MSL	GROUND ELE.: **	CASING DE														$\dashv$
DRILL	. RIG	: CM	E			RFAC				grass		Delli	·	1				4
DRILL	ANG	LE:	DENDE: 1404 actable harman	\r					CTOR hom	Fish	ourne	וווזע	ıng,	ınc	•			4
	LE H/		R TYPE: 140# safety hamme	<u> </u>			TEST				PENET	RATIO	ON R	ESIS	TAN	CE		-
DEPTH IN FEET	띪	ITHOLOGY	DESCRIPTION	ļ		용숙					10		30				30 10	ეი
FEE	SAMPLER	ᅙ	OF			80 80 80 80 80 80 80 80 80 80 80 80 80 8	WATER CONTENT %	LIQUID	PLASTICITY INDEX		10	1	T	Ť	Ť	T		T
ă	SA	LITI	MATERIAL	<u> </u>		목때	* ō		4= 4=									$\prod_{i}$
							1		一丁			T	$\overline{T}$				П	T
<u> </u>			surface grass	lhe brown														
				lay (CL) very sandy, silty, brown and gray														
-			* *	om 1 to 5'														
L_5-																		
_			Bottom of Boring @ 5'	bulk sample from 1 to 5'														
Ė																		
F																		
-10			maximim dry density =	116 pcf								ļ					$\  \ $	
F			optimum moisture conte		ļ													
r			CBR @ 0.1" = 5.5															
			CBR @ 0.2" = 5.2								İ							
<u>-15</u>																		
<b> </b>   "			** boring location not s	surveyed					,				ļ					ļ
F						!												
<b> </b>											ļ				1			
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20														Ì				
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- 30																		
<b>†</b>																		

	·	so	IL BOR	EH	Ol	LE	LC	)G									
SITE NAM	IE AN	D LOCATION:	DRILLING ME	THOD:	CO	ntin	uous	flig	ht aug	er		BORI	NG N	NUM	BEF	₹	
		F-22 Beddown Facility									4		LO-	6			
_		Langley Air Force Base	04450 1410 111			\L					十						ᅦ
		Hampton, Virginia	SAMPLING MI	ETHOD	): (G	rab					+		NOU I	INIC			4
BORING L	OCA.	FION:							<del></del> -		+-	STA	RILL	_	FINI	<u>сп</u>	ㅓ
Bokino	-004	1011.	WATER LEV	FI	Tne	ot o	ncou	ntor	od	Ī	+	TIM		+	TIM		ᅦ
DBO JECT	· KILIBA	BER: 00-062	TIME		Т"	OL E	<u>IICOU</u>	HE	EU		7			1		_	1
PROJECT	NUM	BER: 00-002	DATE		T						$\top$	DAT	ΓE	十一	DA	TE	ㅓ
DATUM: F	T MSL	GROUND ELE.: **	CASING DE	PTH													
DRILL RIG	3: CN	1E		SURF	AC	E CC	ITION	ONS	gras	s							
DRILL AN	GLE:	900							રઃ Fish	burne	Dril	ling	Inc	•			
SAMPLE H	IAMM	ER TYPE: 140# safety hamme	r	LOGG			M. T		nas								_
ی ا ی	გ	DESCRIPTION		je.	z T		RESU			PENET	RATI	ON F	RESIS	TAN	CE		
DEPTH IN FEET SAMPLER	LITHOLOGY	OF		BLOWS per		WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		10	20	30	40	6	0 8	80 1	100
AMF	<u>F</u>	MATERIAL		EO C	낊	VA STA	33	INDI								Ш	
S					_								<del> </del>	1 1	<del>+</del>	<u> </u>	╝
L		surface grass								1		١					
<b>-</b>		Clay (CL) very sandy, sil	ty, brown			1											
<b>-</b>		and gray															
<b> </b>		collected bulk sample from	om 1 to 5'														
<del>  5</del>	1	D-4 of Doring @ 51		-1	ŀ					İ							
	1	Bottom of Boring @ 5'				1									ŀ		
-												1					
<b> -</b>																	
-10		maximim dry density = 1	17 pcf														
┡		optimum moisture conte	ent = 12.5%														
<b>i</b>		CBR @ 0.1" = 5.5 CBR @ 0.2" = 6.5								[			Ì				
		CBI(@ 0.2 = 0.3				İ				İ					.		
<u>15</u>																	
-		** Boring location not s	urveyed														$ \   $
<b>-</b>																	
F																	
20																	
<b> </b> -		1			1												
<b>F</b>																	П
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- 30		1							Ì							Ì	
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			SO SO	IL BOR	EHC	LE	LC	OG							
SITE	NAME	F	LOCATION: 22 Beddown Facility	DRILLING ME started dri of QuickG	lling @	nud i 8 fee	rotar et, us	y with sed a	tricone bit bout 1/4 ba	_	BOR	ING N		BER	₹
			_angley Air Force Base	SAMPLING MI		Split	Sno	on S	ampler	$\neg \Gamma$					
		r	Hampton, Virginia	with 2 turn			<del></del>			+		ORILL	ING		
BORII	NG LO	OCATI	ON:	WICH Z CON	15 01 10	ре о	11 1110	Call	lead	+	STA		<del>-</del>	FINIS	SH
				WATER LEV	EL	6.0				_	TIN	1E		TIM	E
PROJ	ECT I	NUMB	er: 00-062	TIME		13:4	5				13:	30		14:0	00
				DATE		1/10/	01				DA			DA	
DATU	M: FT	MSL	GROUND ELE.: **	CASING DE					]		1/10	1/01	1	/10	)/()1
		: CM							grass						
		LE:		<b></b>					: Fishburne	e Dri	lling	, inc			
	LE H/		R TYPE: 140# safety hamme	<u>)</u>	LOGGI	<del></del>	: M. RES		nas PENE	TDAT	ION:	DEGIG	14 A T	CE	
ੂ_	אָן	)GY	DESCRIPTION		BLOWS per	8									20.4
DEPTH IN FEET	SAMPLER	ПТНОСОБУ	OF		NS TO	WATER CONTENT %	LIQUID	PLASTICITY INDEX	1	υ 2 	0 31 	40	1 1	3 6	)U 1
ద _	SAN	🚊	MATERIAL	<u> </u>	ŠNO	75	PLAS N								
			SAND (SC), fine grained	d clayey	$\pm$				·	1				〒	
-			medium dense, gray/bro		19					l i					
	+				19										
•			CLAY (CL), sandy, stiff	sandy, stiff to very stiff,											
			mottled yellow, brown a	nd gray	14									1	
	Ц.														
•	!		SAND (SC/SM), v. fine-(												
	┝┼╌	<del> </del>	silty, mottled yellow, bro	wn and gray	/  5				- 1						
-			SAND (SM), very fine-g	rained, silty											
-10 -			loose to medium dense	, dark bluist					\			1			
- -			gray, with trace shell fra	gments											
_	<u>L</u>								\						Ш
-					8				\						Ш
<b>-</b> 15	$oxed{\sqcup}$	-				1		i	\						Ш
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_	Π				12										
-20	$\coprod$	.]												.	
			4												
-															
_	$\vdash$	1			4.4										
					14										
<del>25</del> · 		<b>†</b> ·	Rottom of Boring @ 25		1										
-			Bottom of Boring @ 25												
•			** Boring location not su	rveved							1				
ı			** Boring location not su	i veyeu											
<b>–</b> 30															
	1		}		ı	1	1	i	Ī	1	1	1 1	- 1	ıΙ	1

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SITE	NAME		LOCATION: F-22 Beddown Facility	DRILLING ME started dril	ling @	nud 8 fe	rotai et, u	ry with	n tricone about 1/	e bit 4 bag		RING I		BE	R
			angley Air Force Base	of QuickG							_				
		ł	Hampton, Virginia	SAMPLING ME					<del></del>		<del> </del>				
		0047	<b></b>	with 2 turr	ns of ro	pe o	n th	e catl	nead		1	DRILL	ING		
BOKI	NG L	OCATI	ON:			F 6		1	1		_	ART ME	╫	FINI	
			00.000	WATER LEV	EL	5.5	-	-			L	:00		15:	
PROJ	ECT	NUMB	er: 00-062	DATE		15:1			<del></del>			ATE	╁	DA	TE
DATU	M: FT	MSL	GROUND ELE.: 5.97 ft		PTH	1/10/	01				_	0/01			)/01
		: CM		0,10,110,00	SURFA	CE C	JNDI.	TIONS	grass				-		
DRILL			900						R: Fishb		Drilling	a. Inc	· ·		
			R TYPE: 140# safety hamme	r	LOGG							<b>.</b>			
		. 1			ر و د	TES	RES	SULTS	Р	ENETF	RATION	RESIS	ATA	ICE	
DEPTH IN FEET	SAMPLER	тногод	DESCRIPTION		BLOWS per	й. %	_ %	Ĕ		10	20	30 40	6	0	80 10
EP FE	MΡ	욷	OF MATERIAL		<u>\$</u>	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX					T		$\prod$
<u> </u>	'n	=	IVIVIE IVIVE			ŏ		۵					<u>l.</u>		
-			CLAY (CL), sandy, silty with		23	10									
- 	Ш		subrounded gravel, very stiff,	, dark gray (f	ill)  23	110					Y	1			
-			04115 (00) 5	d alassass	18	17					Λ				
-			SAND (SC), fine-grained medium dense to very lo		h					$\mathcal{A}$					
<del>-</del> 5			brown	ose, grayis	''   8	25									
												1			
_			Percent finer than No. 2	00 = 36.5%	3										
<u>-</u>	╽╼┝╶	<del> </del>			5	31		Ì	\						
-10	╙		SAND (SM/SC), very fin	e-grained,					\ \ \	\		1			
-			silty, clayey with crushed							$\setminus$					11
-			fragments, loose to med	lium dense,	1		ļ			$ \cdot $					
-	一		dark bluish gray		10	34				V					
- 45			Percent finer than No. 2	00 = 14.0%		١٣٠				N.					
<b>-</b> 15 -										- 1\					
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-	-	┨				]					\				
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-20	廾	1				<u> </u>				1	X				
	1	1	•						İ		-  \				
-	<u> </u>	1									\				
_					29	27						1			
-25	╁┸	<del> </del>						1							
<b> </b>			Bottom of Boring @ 25'												
-															
<b>L</b> 30															
l	1	1	Ī		i	1	1	1		ı	1	1 1	- 1	1 1	

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	SO	IL BOR		_								
SITE NAME AND LOCAT	ion: Seddown Facility		lling @	nud 8 fe	rotary et, us	with ed a	n tricone bit about 1/4 ba		BORING   V	NUM T-2	1BEF	₹
	ey Air Force Base	of QuickG						—├				
Hampt	ton, Virginia	SAMPLING ME										
		with 2 turr	ns of ro	pe o	n the	cath	nead	_	DRILL	ING		
BORING LOCATION:					<sub></sub>			_	START		FINI	
		WATER LEV	EL	7.0					TIME 9:15		TIM	
PROJECT NUMBER: 0	0-062	TIME		9:30	1	]				$\perp$	10:	
		DATE		1/15/	01				DATE			TE
DATUM: FT MSL	GROUND ELE.: 6.12 ft	CASING DE	PTH			į			1/15/01	Ц.,	1/1	5/01
DRILL RIG: CME							grass					
DRILL ANGLE: 900							R: Fishburn	e Dr	illing, Inc	).		
SAMPLE HAMMER TYPE	: 140# safety hamme	<u> </u>	LOGG				nas					
z >			ē	TEST	RES	JLTS	PENE	TRA	TION RESI	STA	<b>ICE</b>	
DEPTH IN FEET SAMPLER	DESCRIPTION		BLOWS per	WATER CONTENT %	ō%	ر بِيَ	1	0 2	20 30 40	6	80 8	80 1
MAPI AMPI	OF MATERIAL		68	NATE NATE NATE NATE NATE NATE NATE NATE	LIMIT %	PLASTICITY INDEX						
O   SA   T-1	WAIERIAL		<u></u>	·  _8		5_		ļ				<u> </u>
	ID(00) for a main al		, 53	Τ			.,-			T		TT
	ND(SC), fine -grained, y, with angular gravel t		' i	1				1				
to s		.0 1/2 , Haic	1   15	18				_	111			
-         ""	QIII							Ш				
- 5	cent finer than No. 200	0 = 44.8%	13					$V_{-}$				
			8					]				
-		*										
<del>∤╍╞╸</del> ┩╼╺╸┨╌╶╶╴		<b></b>					(					
-     s/	AND (SM), very fine-gr	rained, silty,	,   `				\					
-10   lo	ose to medium dense,	dark bluis	h				\					
-     gr	ay			1			\					11
-							\					
-			10				\	lacksquare	1 1 1			
- [			10					1				
-15								1\				
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			18					\	\			
-			10	<b>'</b>					\\			
-20 <del>-  </del>			ļ			İ			1			
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			21						<b>)</b>			
_25										1		
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', <u> </u>									'	1		
_			15	; ]				'				
30							1					
	ottom of Boring @ 30'	ı										ļ
								1			11	1

	SOIL BOREHOLE LOG  TE NAME AND LOCATION:  F-22 Beddown Facility  DRILLING METHOD: mud rotary with tricone bit started drilling @ 8 feet, used about 1/4 bag																	
SITE	NAMI		•	DRILLING ME started dri	THOD:	m 3 (c	ud r 3 fee	otary et, us	y with	n tricon about 1	e bit /4 ba	ıg E	BORI	NG BC		MBE	R	
			Langley Air Force Base	of QuickG						-			_	_				
			Hampton, Virginia	SAMPLING M														
200			1014-	with 2 turn	ns of	ор	e or	n the	cat	nead					LING			_
BORII	NG LI	JUAI	ION:	14/4 TED   E\		1		1	. 1		<del></del>		STA		+		NSF	Ш
			00.062	WATER LEV	EL	<del> </del> n	ot e	ncou	unte	ed			1110			11	ME	ı
PROJ	ECT	NUMB	ser: 00-062	DATE		+		+				-	DAT	ΓF	+		ATE	_
DATU	M: FT	MSL	GROUND ELE.: 7.68 ft	CASING DE	PTH	$\dagger$		+			<u> </u>	$\dashv$	571	_		_		
DRILL	. RIG	СМ	E		SURF	AC	E CO	NDIT	IONS	conc	rete	pavir	ng					
DRILL	ANG	LE:	90°							R: Fisht	ourne	e Dril	lling.	, In	C.			
SAMP	LE H/	AMME	R TYPE: 140# safety hamme	r	LOGG	_				nas								
Z	ا ہے ا	ζ	DESCRIPTION		per			RESI	ULTS	I	PENE	TRATI	ON F	RESI	STA	NCE	•	
DEPTH IN FEET	PLE	200	OF DESCRIPTION		WS		ENT %	LIQUID LIMIT %	KCITY EX		10	) 20	0 30	40	) 	60	80	100
DEF	SAMPLER	гітнособу	MATERIAL		BLOWS per	ğ	WATER CONTENT %	LIM LIG	PLASTICITY INDEX									
- -			10.5" of concrete over CLAY(CL), silty, sandy, t	orown														
- 		. – – –	collected bulk sample fro	om 2 to 4'														
Ē			Bottom of Boring @ 5'				1											
- -10 - - - -			maximim dry density = 1 optimum moisture conte CBR @ 0.1" = 10.4 CBR @ 0.2" = 9.2															
-  -  -																		
- - -	Ė		•				:											
-												;						
-25 - - -																		
30			·				1											

			SO	IL BOR	EHC	DLE	E L(	OG			·						
SITE	NAM	E AND	LOCATION:	DRILLING ME	THOD:	conti	nuou	s flia	ht auge	er	E	BORI	NG N	IUMI	BEF	₹	
ł			F-22 Beddown Facility								$\Box$		ВО-	1A			
		1	Langley Air Force Base								╬						$\dashv$
			Hampton, Virginia	SAMPLING MI							+						4
BORI	NG L	OCAT	ION:	with 2 turn	ns of r	ope c	n the	cat	nead		+	STA	RILLI		FINIS	<u></u>	$\dashv$
				WATER LEV	FI	not (	enco	unta	ed	<u> </u>	╫	TIM		+	TIM		$\dashv$
PROJ	ECT	NUMB	ER: 00-062	TIME		HOL	51100	ullic	CU							_	
' '''				DATE								DAT	Έ	T	DA	TE	╛
DATU	M: F1	MSL	GROUND ELE.: 7.90 ft	CASING DE	PTH									<u> </u>			
		: CM			SURF					rete p							_
DRILL									રઃ Fisht	ourne	Dril	ling.	Inc.				
SAMP	LE H	AMME	R TYPE: 140# safety hamme	Γ	LOGG	7											$\dashv$
DEPTH IN FEET	뽔	)GY	DESCRIPTION		BLOWS per	IES *	T RES			PENET							
F H H	SAMPLER	гі <b>т</b> ногосу	OF		NS T	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX		10 T	20	) 30	40	60 T T	3 (	30 1 T T	100
<u> </u>	SAN	Ė	MATÉRIAL		BLO D	2  §8 -  §8	] ==	PLAS					ļ				
						<del> </del>								$\overline{\Box}$	十	Ħ	H
L :			10.0" of concrete over	سينمسط بطائ													
			CLAY(CL), very sandy, s Petrolenm odor	sity brown													
Ļ			collected bulk sample from	nm 1 to 5'													
<del>-5</del> -																	
			Bottom of Boring @ 5'							- 1							
ſ																	
L <sub>10</sub>			maximim dry density = 1	14 ncf													
-			optimum moisture conte														
F			CBR @ 0.1" = 5.9														
<b> </b>			CBR @ 0.2" = 4.9														
١.,							1										$  \    $
<del>-</del> 15														1			
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,			SO	IL BOR	EHC	LE	LC	)G		<u> </u>		·			7
SITE	NAME	F	LOCATION: F-22 Beddown Facility	DRILLING ME started dril of QuickG	ling @	nud 8 fe	rotar et, us	y wit sed a	n tricon about 1	e bit /4 bag	BORII	NG N 80-2	UMB	ΞR	
			_angley Air Force Base Hampton, Virginia	SAMPLING ME		Split	Spo	on S	ampler		- p:	age	1 of :	2	
			<b>5</b>	with 2 turr	s of ro	pe o	n the	cat	nead		D	RILLII	NG		
BORI	NG L	OCATI	ON:			<u> </u>					STAF			NISH	4
DDQ (	COT I		er: 00-062	WATER LEVI	EL	5.0	_				12:1	_		ME :10	ı
PROJ	EGII	NOMB	ER: 00-002	DATE		12:3 1/16/0					DAT	E		ATE	┨
DATU	M: FT	MSL	GROUND ELE.: 8.55 ft	CASING DE	PTH	17 1 🗘					1/16/	′01	1/1	6/01	
		СМ									over 2"		"-sto	ne	
DRILL										ourne	Drilling,	Inc.			4
	LE HA	ı	R TYPE: 140# safety hamme	Γ ]	LOGGI	1	: M. RES			DENIETE	ATION D	Eeler	ANO		4
DEPTH IN FEET	굒	ITHOLOGY	DESCRIPTION		BLOWS per	* F3		$\overline{}$			RATION R				ٳ؞
PPTH	SAMPLER	호	OF		N C	WATER CONTENT %	LIMIT %	PLASTICITY INDEX		10 	20 30	40	50	80 10	Т
ä	SAI	Ė	MATERIAL		B.C.	SS	ר ר	P FA							
- - - - - - - 10			concrete, stone and san SAND(SC), v. fine-graine medium dense, with few pebbles, medium brown Percent finer than No. 20 Petroleum odor @ 5 to 8 SAND(SM), v. fine-grain medium dense, some shipellow brown	ed, very clay subrounded 0 = 48.7% 3' ed, silty, nell fragmen	15 - 10	18 17 21 31 30	38	22							
- 15  			SAND(SM), very fine-gra loose, with some shell f (whole shells to 1/4" and large shells), bluish gray	ragments I pieces of	10	32									
- 20 			trace shells from 24'		9	33									

	SO	IL BOR	EHC	LE	LC	G				-		
SITE NAME AND LOC	ATION: 2 Beddown Facility			nudu 8 fe	rotary et, us	wit	h tricone bit about 1/3 bag	BOF	ING N		BER	
	gley Air Force Base	of QuickG		C=1:4	C	0		<u> </u>	age 2			
Ham	npton, Virginia	SAMPLING ME						<del>  `</del>	DRILL			
BORING LOCATION:		with 2 turn	15 01 10	pe o	n the	cau	nead	+	ART	_	FINIS	.H
		WATER LEV	EL	5.0.				TII	ME		TIME	_
PROJECT NUMBER:	00-062	TIME		12:30	0			12	:15		1:10	٥
		DATE		1/16/0	)1				TE	Γ.	DAT	
DATUM: FT MSL	GROUND ELE.: 8.55 ft	CASING DE							6/01	—	1/16	
DRILL RIG: CME							7" concrete				tone	}
DRILL ANGLE: 900							R: Fishburne [	Orilling	, Inc.			
	PE: 140# safety hamme	r	LOGGE		RES			ATION	DEOLO	T A B I	<u></u>	-
DEPTH IN FEET SAMPLER LITHOLOGY	DESCRIPTION		BLOWS per FOOT (N)	, E31		-						
DEPTH IF FEET SAMPLER THOLOG	OF		NS TO	WATER CONTENT %	LIQUID	PLASTICITY INDEX	10	20 3	0 40	60	א נ רד	0 100
SAN	MATERIAL		의 의	CON	-5	PLAS						
- 35 - 40 - 45	(continued) SAND(SM), grained, silty, loose, with fragments (whole shells pieces of large shells), but uniform texture from 25'  Bottom of Boring @ 45'	some shel to 1/4" and luish gray	19 12									

			SO	IL BOR	EHC	LE	LC	G								
SITE	NAM		LOCATION: F-22 Beddown Facility	DRILLING ME		nud 8 fe	rotary et, us	with	n tricone about 1/4	bit bag	BOF	RING BO-		VIBE	:R	
1			Langley Air Force Base	of QuickG		0-14	Conn	0								
			Hampton, Virginia	SAMPLING MI with 2 turi		<u> </u>	<del></del>					DRILL	INC		_	
BORI	NG L	OCAT	ion: Base Operations Bldg.	With Z turi	15 01 10	pe o	ii uie	Call	leau		-	ART	T		IISH	彐
				WATER LEV	EL	5.0					TII	ME	$\dagger$	TII	ME	
PROJ	ECT	NUME	BER: 00-062	TIME		12:1	5				11:	50	$\perp$	1:	30	
				DATE		1/16/0	)1				1	TE			ATE	
DATU				CASING DE	<u>*</u>				4 E" of	faana	<u> </u>	6/01	$\bot$	1/1	6/0	
DRILL DRILL					SURFA				4.5" of R: Fishbu			ı Inc				$\dashv$
			R TYPE: 140# safety hamme	Γ	LOGGE					AIII L	i mini	, ۱۱۱۲	<u>,</u>			$\dashv$
					T		RESU			NETR/	ATION	RESI	STA	NCE	=	ヿ
DEPTH IN FEET	LER	LOG	DESCRIPTION		BLOWS per FOOT (N)	¥.₽	% ⊑	Ϋ́		10	20 3	0 40	ı	60	80	100
	AMP	THO	MATERIAL		30  30  30  30  30  30  30  30  30  30	WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX					T	$\prod$	T	$\prod$
	Ŋ	٦				Ō		ā					<u> </u>	<u> </u>	ᆜ	Щ
- - - - - - - - - - - - - - - - - - -	4.5" concrete CLAY (CL), v. silty with pieces of asphalt, stiff, petroleum odor (fill)  SAND(SM), very fine-grained, silty, with some shell fragments, loose to medium dense, petroleum odor, mottled yellow brown  Percent finer than No. 200 = 19.1%  SAND(SM), very fine-grained, silty with some shell fragments, loose, bluish, gray  Percent finer than No. 200 = 14%					30										
-20 - - - 25- - - - 30	bluish, gray Percent finer than No. 200 = 14%  trace shells below 18'  Bottom of boring @ 25'															

			so	IL BOR	Eŀ	10	LE	LC	G						_			
SITE	NAME	E AND	LOCATION:	DRILLING ME	THO	D: co	ontir	านดนร	flig	nt auge	ar .	E	BORI	NG	NUN	IBE	R	
•		l	F-22 Beddown Facility									4		во	-4			
1			Langley Air Force Base	CAMPI INC. 14	CT! 10	ND: 6	\na b	<del></del>				十						$\neg$
		1	Hampton, Virginia	SAMPLING MI	ETHO	יט: (	or ab	!				-		יווקו	LING	—		$\dashv$
BORII	NG L	OCAT	ION:										STA		T	FIN	ISH	$\dashv$
				WATER LEV	EL	Tr	not e	encou	ınter	ed			TIM			TIN		$\dashv$
PROJ	ECT I	NUMB	er: 00-062	TIME														
				DATE									DAT	E		D#	ΛΤΕ	
DATU			GROUND ELE.: **	CASING DE	r						<u> </u>							_
DRILL	RIG	: CM	<u>E</u>					NDIT		3.5 ir								$\dashv$
DRILL			R TYPE: 140# safety hamme	r				M. T		: Fisht	ourne	וחט	ııng,	inc	<b>3</b> .	—		
	LE M/		K TIPE: 140# Salety Hailille					RESL	_		PENE1	RATI	ON R	RESI	STAN	ICF		_
DEPTH IN FEET	Ë	гітносос <del>у</del>	DESCRIPTION		6	≍ 숙⊦		- 1		,	10		30			0	80	100
EPTH FEET	SAMPLER	된	OF MATERIAL		}	86	WATER CONTENT %	LIQUID LIMIT &	PLASTICITY INDEX				, 33 T	<del>- 7</del>	Т	ĬΤ	Ť	П
۵	SA	LIT	MATERIAL		ă	묙굔	78		7 =									
			0 F inches of											$\overline{T}$	T	П	Τ	П
			<ol> <li>3.5 inches of asphalt SAND (SC) very clayey,</li> </ol>	silty brown									İ	-				$\  \ $
-			0/111D (00) 1013 014303;	only brown	İ	1												
- 			collected bulk sample from	om 1 to 5'														
r			Bottom of Boring @ 5'															
<u> </u>		:	** Boring location covered pile when area was surve	_	1													
-10		i	plie Wileri alea was sulve	y <del>c</del> u.	ļ	=												
-																		
<u> </u>																		
<b>—</b> 15																		
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			SO	IL BOR	EH	10	LE	LC	)G									
SITE	NAMI	E AND	LOCATION:	DRILLING ME	THO	D: Co	ontin	uous	s flig	ht auge	ar	{E	BORI	NG	NU	МВ	ΞR	
•			F-22 Beddown Facility									$\dashv$		BC	)-5			
ı			Langley Air Force Base	SAMPLING MI	ETHO	)D. (	Grah					-						$\dashv$
		ı	Hampton, Virginia	DAIVIT LING IVII		<i>.</i> (	JIAU	•	<del></del>	<del></del>		_	Г	ORIL	LIN			$\dashv$
BORI	NG L	OCATI	ION:										STA		T		NISH	一
				WATER LEV	EĻ	r	not e	erico	unte	red			TIM	!E	T	TI	IME	
PROJ	ECT !	NUMB	ER: 00-062	TIME											$\bot$			
l			00011110 51 5 . 7 04 5	DATE		-		+				4	DAT	ΓE		0	DATE	=
DATU			GROUND ELE.: 7.81 ft	CASING DE			\F_00	<u> </u>	10110	arace	<u> </u>				_			
DRILL	. RIG:	CM	900					NDIT NTRA		gras: Fishl:		Dril	lina	In				$\dashv$
SAMP	LE H	AMME	R TYPE: 140# safety hamme	r				M. 1			Juine	, 0111	ııı ı <u>y</u>	, 111	<u>J.</u>			-
				•	$\overline{}$			RES			PENE	TRATI	ON F	RESI	STA	ANC	E	ヿ
DEPTH IN FEET	SAMPLER SAMPLER DESCRIPTION OF TOTAL CONTENT & MATERITY NOT TOTAL CONTENT								20	0 30	40	}	60	80	100			
JEP.	AMP	욷					WATE	UOI1	ASTIC INDE								П	П
<u> </u>	S				a	В	٥		<u>a</u>								Щ	Щ
_			surface grass			l	İ											
-			SAND (SC) very clayey,	silty brown														
<u> </u>			collected bulk sample fro	om 1 to 5'								:						
L5					-+													
			Bottom of Boring @ 5'														11	
<u> </u>													. !					
F					Ì													
-10			maximim dry density = 1															
<b> </b>			optimum moisture conte	nt = 18%														
Ĺ			CBR @ 0.1" = 5.0 CBR @ 0.2" = 4.4															
Ę.			OBIT (@ 0.2 - 4.4				ļ											
-15																		
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			SO	IL BOR	EHO	DLE	LC	G			,						
SITE	NAME	AND	LOCATION:	DRILLING ME	THOD:	conti	nuous	flig	ht auge	€L		BORI	NG I	NUN	/BE	R	
		F	F-22 Beddown Facility								4		ВО	-6			
			angley Air Force Base	04400 1010 441	ETHOR	<u> </u>					一	-			· ·		$\dashv$
		ŀ	Hampton, Virginia	SAMPLING MI	ETHOD	Grai	<u> </u>						RILL	INC			$\dashv$
BORII	NG LO	CATI	ON:								_	STA		ING		ISH	
				WATER LEV	EL	not e	encou	nter	 ed		+	TIM		$\dagger$	TIM	_	$\dashv$
PROJ	ECT N	IUMB	er: 00-062	TIME		1											
				DATE								DAT	ΓE		D/	ATE	
DATU	M: FT	MSL	GROUND ELE.: 7.13 ft	CASING DE	PTH					<u> </u>							_
DRILL									gras								_
DRILL									R: Fisht	ourne	Dril	ling.	, Inc				_
SAMP	LE HA		R TYPE: 140# safety hamme	ſ	·		M. T			DENET	DATI	ONE	areie	`T & 1	JCT.		-1
DEPTH IN FEET	굙	LITHOLOGY	DESCRIPTION		BLOWS per	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		_		PENET							100
	SAMPLER	호	OF		NS S	WATER CONTENT?	LIMIT %	PLASTICITY INDEX		10 	) 20	) 3(	) 40 T	Т	30 T T	80	100
<u> </u>	SAN	<u> </u>	MATERIAL		<u> </u>	≥Š	-5	PLAS									
					$\pm$								T	T		T	$\overline{\Box}$
-			surface grass	h. beaus								l					Ш
	1		Clay (CL) very sandy, sil- and gray	ty, brown													
_			collected bulk sample from	m 1 to 5'		1						ı					
<del></del> 5										ļ				ļ			
			Bottom of Boring @ 5'											ŀ			
L												İ			$\  \cdot \ $		
<b> </b> -												Ì	ļ			-	
<b>–</b> 10			maximim dry density = 1	15 pcf													
┝			optimum moisture conte							1							
┝			CBR @ 0.1" = 6.4														
┝			CBR @ 0.2" = 5.7			1											
- 15																	
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SITE	NAMI		LOCATION: F-22 Beddown Facility	DRILLING ME started drii	THOD:	nud 8 fe	rotar et, u	y wit sed a	h tricor about 1	ie bit /4 bag	_	PH-1		SEK	
			Langley Air Force Base	of QuickG	el						<u></u>				
			Hampton, Virginia	SAMPLING ME						•	+	age 1		2	
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<u>z</u>	<u> </u>	ΣĞΥ	DESCRIPTION		a g	IES &		_		PENETF					
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_	П		with few rounded pebble dense olive gray	s, mealum	18	15	ļ ļ				1				
		 		(fill)_	''	'									
<del>-</del> 5			SAND (SM), v. fine-grained	silty with fi	ne 8	20						1			
	$\vdash$	<u> </u>	roots to 1/4" diameter, loose			22									
			SAND (SM), v. fine-grained, silt		- 1 -										
	<b>│</b> -	<b> </b>	Percent finer than No. 200 = 27	.2%	2	31					l				
<b>-10</b>			SAND(SM), very fine-gra	ained, silty,							1				
<b></b>			clayey, very loose to loo						\					11	
-			Daniel Carallan Na O	00 - 04 70/						$\setminus \bot$					
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			angley Air Force Base	of QuickGe							ᅪ				_	
		ŀ	Hampton, Virginia	SAMPLING ME			<u> </u>			<u> </u>	$\bot$		ige 2		2	
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SAMPI	LE HA	AMME	R TYPE: 140# safety hamme	r	LOGGE											
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•			clayey, very loose to loo	se, gray												
_					10	34										
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# APPENDIX B LABORATORY TEST RESULTS

# Soil Classification Calculations

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW Draper Aden Associato Blacksburg + Richmond, Virginia Engineering • Surveying • Environmental Services

Sample ID L0-1 Sample Depth 0-2' Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

Pan ID

Pan Wt

192.33 grams

Pan + Soil (wet)

335.72 grams

Pan + Soil (dry)

318.79 grams

Natural Moisture Content

13.4%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

272.11 grams

Percent Passing No. 200 Sieve

36.9%

Pan + Soil retained on No. 4 sieve

(dry)

203.00 grams

Percent Passing No. 4 Sieve

91.6%

Soil Classifies as Coarse-Grained Soil

# **Atterberg Limits**

Liquid Limit

No of Blows	19	26	33
Pan ID	65	62	121
Pan Wt	10.98	10.90	11.24
Pan + Soil (wet)	16.54	17.56	16.79
Pan + Soil (dry)	14.98	15.74	15.29
Moisture Content	39%	38%	37%
Liquid Limit	38	38	38

Liquid Limit 38

**Plastic Limit** 

Pan ID		29
Pan Weight	2.39	2.39
Pan + Soil (wet)	12.73	13.44
Pan + Soil (dry)	11.10	11.72
Moisture Content	19%	18%

Plastic Limit

19

Plastic Index

19

### **USCS Classification**

**Group Symbol** 

SC

Group Name Clayey SAND

**Draper Aden Associates** 

Blacksburg • Richmond, Virginia

Engineering • Surveying • Environmental Services

# Grain Size Distribution Calculations

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW

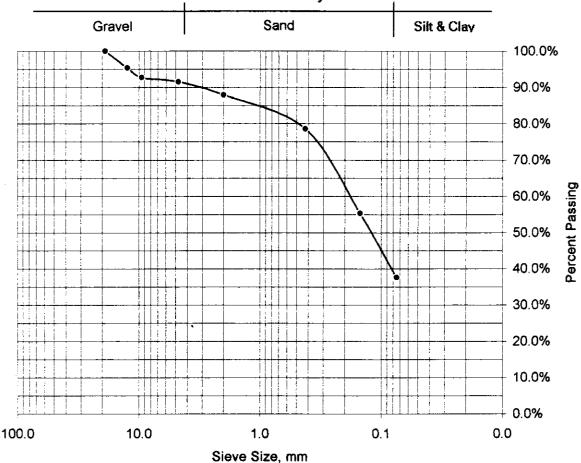
Sample ID L0-1

Sample Depth 0-2'

## Mechanical Sieve Analysis

Sieve	Weight	Percent	Sieve	Percent
Size	Retained	Retained	Size, mm	Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	5.85	4.6%	12.5	95.4%
3/8"	3.34	2.6%	9.5	92.7%
No. 4	1.48	1.2%	4.75	91.6%
No. 10	4.63	3.7%	2.0	87.9%
No. 40	11.74	9.3%	0.425	78.6%
No. 100	29.48	23.3%	0.15	55.3%
No. 200	22.26	17.6%	0.075	37.7%
Pan	0.80	0.6%		
Total	79.58	62.3%		

### Sieve Analysis



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID L0-1
Sample Depth 4'-6'
Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

Pan ID 37

Pan Wt 193.57 grams

Pan + Soil (wet) 328.14 grams

Pan + Soil (dry) 312.72 grams

Natural Moisture Content 12.9%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 268.50 grams

Percent Passing No. 200 Sieve

37.1%

Pan + Soil retained on No. 4 sieve

(dry)

204.00 grams

Percent Passing No. 4 Sieve

91.2%

Soil Classifies as Coarse-Grained Soil

# **Atterberg Limits**

Liquid Limit

No of Blows	35	26	19
Pan ID	93	105	103
Pan Wt	30.12	29.31	27.4
Pan + Soil (wet)	39.93	37.43	34.67
Pan + Soil (dry)	36.25	34.31	31.83
Moisture Content	60%	62%	64%
Liquid Limit	63	63	62

. LIG

Liquid Limit 63

**Plastic Limit** 

Pan ID D	В	
Pan Weight	2.42	2.42
Pan + Soil (wet)	13.40	12.01
Pan + Soil (dry)	11.10	10.03
Moisture Content	26%	26%

Plastic Limit

26

Plastic Index 36

### **USCS** Classification

Group Symbol

SC

Group Name Clayey SAND

Draper Aden Associates
Blacksburg • Richmond, Virginia

Engineering • Surveying • Environmental Services

# **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

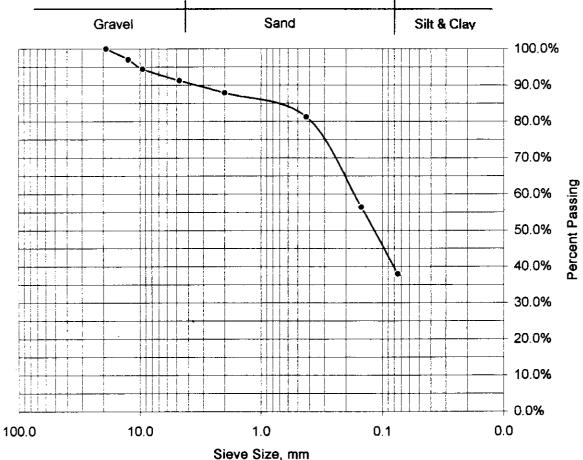
DAA # R01121-01 Prepared By: LTW

> Sample ID L0-1 Sample Depth 4'-6'

# Mechanical Sieve Analysis

Sieve	Weight	Percent	Sieve	Percent
Size	Retained	Retained	Size, mm	Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	3.51	2.9%	12.5	97.1%
3/8"	3.15	2.6%	9.5	94.4%
No. 4	3.77	3.2%	4.75	91.2%
No. 10	4.00	3.4%	2.0	87.9%
No. 40	7.96	6.7%	0.425	81.2%
No. 100	29.58	24.8%	0.15	56.4%
No. 200	21.94	18.4%	0.075	38.0%
Pan	0.50	0.4%		
Total	74.41	62.0%		





Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-1 Sample Depth 13'-15' Visual Sample Description Brown Silty SAND

### **Natural Moisture Content**

Pan ID 33

Pan Wt 193.66 grams

Pan + Soil (wet) 286.18 grams

Pan + Soil (dry) 263.67 grams

Natural Moisture Content 32.2%

### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 257.03 grams

Percent Passing No. 200 Sieve 9.5%

**Draper Aden Associates** Blacksburg • Richmond, Virginia Engineering • Surveying • Environmental Services

Sample ID LO-2 Sample Depth 0'-2'

# **Natural Moisture Content**

Pan ID A-111

Pan Wt 8.16 grams

Pan + Soil (wet) 73.82 grams 60.94 grams

Pan + Soil (dry)

Natural Moisture Content 24.4%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-2 Sample Depth 2'-4'

#### **Natural Moisture Content**

Pan ID A-110

Pan Wt 8.15 grams

Pan + Soil (wet) 162.29 grams

Pan + Soil (dry) 139.32 grams

Natural Moisture Content 17.5%

Prepared By: LTW



Sample ID LO-2 Sample Depth 4'-6'

# **Natural Moisture Content**

Pan ID A-105

Pan Wt 8.12 grams

Pan + Soil (wet) 134.56 grams

Pan + Soil (dry) 101.50 grams

Natural Moisture Content 35.4%

Prepared By: LTW



Sample ID LO-2 Sample Depth 6'-8'

# **Natural Moisture Content**

Pan ID A-100

Pan Wt 8.14 grams

Pan + Soil (wet) 137.56 grams

Pan + Soil (dry) 102.82 grams

Natural Moisture Content 36.7%

Prepared By: LTW



Sample ID LO-2 Sample Depth 8'-10'

# **Natural Moisture Content**

Pan ID A-102

Pan Wt 8.19 grams

Pan + Soil (wet) 129.86 grams

Pan + Soil (dry) 98.74 grams

Natural Moisture Content 34.4%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-2 Sample Depth 13'-15'

#### **Natural Moisture Content**

Pan ID A-104

Pan Wt 8.31 grams

Pan + Soil (wet) 134.45 grams

Pan + Soil (dry) 103.29 grams

Natural Moisture Content 32.8%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-2
Sample Depth 18'-20'
Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 26

Pan Wt 194.58 grams

Pan + Soil (wet) 327.69 grams

Pan + Soil (dry) 297.70 grams

Natural Moisture Content 29.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 284.74 grams

Percent Passing No. 200 Sieve 12.6%

Pan + Soil retained on No. 4 sieve

(dry) 194.58 grams

Percent Passing No. 4 Sieve 100.0%

Soil Classifies as Coarse-Grained Soil

# **Atterberg Limits**

Liquid Limit

No of Blows			
Pan ID			
Pan Wt		Non-Plastic	
Pan + Soil (wet)			
Pan + Soil (dry)			
Moisture Content	0%	0%	0%
Liquid Limit	0	NA	NA
Liquid Limit	0		

#### **Plastic Limit**

Pan ID Pan Weight		
Pan + Soil (wet)	Non-	Plastic —
Pan + Soil (dry)		
Moisture Content	0%	0%
Plastic Limit	0	
Plastic Index	0	

#### **USCS** Classification

Group Symbol SM
Group Name Silty SAND

# **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW

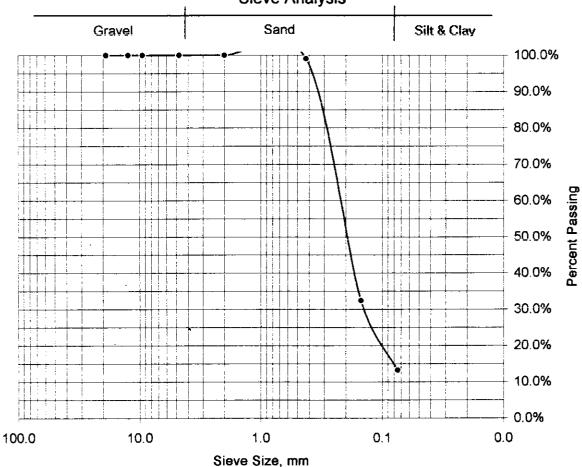
> Sample ID LO-2 Sample Depth 18'-20'

Mechanical Sieve Analysis



Weight Percent Sieve Sieve Percent Size Retained Retained Size, mm Passing 3/4" 0.00 0.0% 19.0 100.0% 1/2" 0.00 0.0% 12.5 100.0% 3/8" 0.00 0.0% 9.5 100.0% No. 4 0.00 0.0% 4.75 100.0% No. 10 0.00 0.0% 2.0 100.0% No. 40 1.00 1.0% 0.425 99.0% No. 100 68.68 66.6% 0.15 32.4% No. 200 19.79 19.2% 0.075 13.2% Pan 0.53 0.5% Total 90.00 86.8%

Sieve Analysis





Sample ID LO-2 Sample Depth 23'-25'

# **Natural Moisture Content**

Pan ID A-107

Pan Wt 8.13 grams

Pan + Soil (wet) 104.83 grams

Pan + Soil (dry) 82.88 grams

Natural Moisture Content 29.4%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-2 Sample Depth 28'-30'

# **Natural Moisture Content**

Pan ID A-101

Pan Wt 8.17 grams

Pan + Soil (wet) 124.71 grams

Pan + Soil (dry) 98.71 grams

Natural Moisture Content 28.7%

Prepared By: LTW



Sample ID LO-2 Sample Depth 33'-35'

# **Natural Moisture Content**

Pan ID A-106

Pan Wt 8.30 grams

Pan + Soil (wet) 145.40 grams

Pan + Soil (dry) 112.40 grams

Natural Moisture Content 31.7%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-2 Sample Depth 38'-40' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 15

Pan Wt

188.26 grams

Pan + Soil (wet)

355.36 grams

Pan + Soil (dry)

315.21 grams

Natural Moisture Content

31.6%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

293.52 grams

Percent Passing No. 200 Sieve

17.1%

**Draper Aden Associates** Blacksburg • Richmond, Virginia Engineering • Surveying • Environmental Services

Sample ID LO-2 Sample Depth 43'-45'

#### **Natural Moisture Content**

Pan ID A-103

Pan Wt 8.26 grams

Pan + Soil (wet) 166.26 grams Pan + Soil (dry) 126.35 grams

Natural Moisture Content 33.8%

Draper Aden Associates

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Engineering • Surveying • Environmental Services

Sample ID LO-2 Sample Depth 48'-50'

#### **Natural Moisture Content**

Pan ID A-109

Pan Wt 8.26 grams

Pan + Soil (wet) 124.97 grams

Pan + Soil (dry) 97.12 grams

Natural Moisture Content 31.3%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-3
Sample Depth 0'-2'
Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

 Pan ID
 23

 Pan Wt
 193.96 grams

 Pan + Soil (wet)
 339.64 grams

 Pan + Soil (dry)
 323.09 grams

 Natural Moisture Content
 12.8%

### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 281.12 grams
Percent Passing No. 200 Sieve 32.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-3 Sample Depth 13'-15' Visual Sample Description Gray Silty SAND

# **Natural Moisture Content**

Pan ID

Pan Wt

184.05 grams

10

Pan + Soil (wet)

300.95 grams

Pan + Soil (dry)

272.89 grams

Natural Moisture Content

31.6%

### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

263.78 grams

Percent Passing No. 200 Sieve

10.3%

Pan + Soil retained on No. 4 sieve

(drv)

184.05 grams

Percent Passing No. 4 Sieve

100.0%

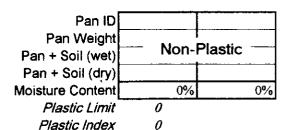
Soil Classifies as Coarse-Grained Soil

# **Atterberg Limits**

Liquid Limit

No of Blows			
Pan ID			
Pan Wt		Non-Plastic	
Pan + Soil (wet)			
Pan + Soil (dry)			
Moisture Content	0%	0%	0%
Liquid Limit	0	NA	NA
Liquid Limit	0		

#### **Plastic Limit**



#### **USCS Classification**

Group Symbol SM
Group Name Silty SAND

# **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

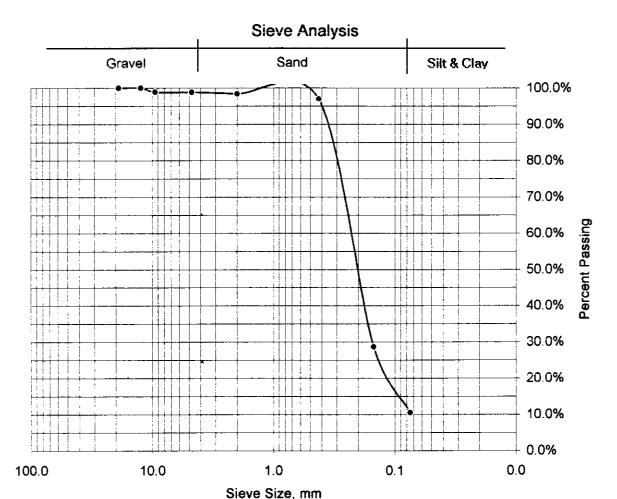
Prepared By: LTW

Sample ID LO-3 Sample Depth 13'-15'

Mechanical Sieve Analysis



Sieve Weight Percent Sieve Percent Size Retained Retained Size, mm Passing 3/4" 0.0% 0.00 19.0 100.0% 1/2" 0.00 0.0% 12.5 100.0% 3/8" 0.97 1.1% 9.5 98.9% No. 4 0.05 0.1% 4.75 98.9% No. 10 0.45 0.5% 2.0 98.3% No. 40 1.28 1.4% 0.425 96.9% No. 100 60.58 68.2% 0.15 28.7% No. 200 16.14 18.2% 0.075 10.5% Pan 0.07 0.1% Total 79.54 89.5%



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-3 Sample Depth 18'-20' Visual Sample Description Gray Silty SAND

# **Natural Moisture Content**

Pan ID

Pan Wt 196.21 grams

Pan + Soil (wet) 352.45 grams

Pan + Soil (dry) 316.64 grams

Natural Moisture Content 29.7%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 304.29 grams

Percent Passing No. 200 Sieve 10.3%

Draper Aden Associates

Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID LO-4 Sample Depth 0'-2'

#### **Natural Moisture Content**

Pan ID A-108

Pan Wt 8.19 grams

Pan + Soil (wet) 162.15 grams

Pan + Soil (dry) 144.33 grams

Natural Moisture Content 13.1%



Sample ID LO-4 Sample Depth 2'-4'

#### **Natural Moisture Content**

Pan ID 39

Pan Wt 193.02 grams

Pan + Soil (wet) 297.61 grams

Pan + Soil (dry) 278.63 grams

Natural Moisture Content 22.2%



Sample ID LO-4 Sample Depth 6'-8'

# **Natural Moisture Content**

Pan ID 28

Pan Wt 193.21 grams

Pan + Soil (wet) 346.24 grams 310.30 grams

Pan + Soil (dry)

Natural Moisture Content 30.7%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID LO-4 Sample Depth 8'-10' Visual Sample Description Gray Clayey SAND

### **Natural Moisture Content**

Pan ID 18
Pan Wt 189.07 grams
Pan + Soil (wet) 278.82 grams
Pan + Soil (dry) 253.69 grams

Natural Moisture Content 38.9%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 245.60 grams

Percent Passing No. 200 Sieve 12.5%

Prepared By: LTW



Sample ID LO-4
Sample Depth 13'-15'
Visual Sample Description Gray Silty SAND

### **Natural Moisture Content**

Pan ID 21

Pan Wt 193.76 grams

Pan + Soil (wet) 347.21 grams

Pan + Soil (dry) 309.09 grams

Natural Moisture Content 33.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 297.53 grams

Percent Passing No. 200 Sieve 10.0%

DAA # R01121-01

Prepared By: LTW



Sample ID LO-4 Sample Depth 18'-20'

# **Natural Moisture Content**

Pan ID 30

Pan Wt 193.90 grams

Pan + Soil (wet) 323.00 grams

Pan + Soil (dry) 294.50 grams

Natural Moisture Content 28.3%

Prepared By: LTW



Sample ID LO-4 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID 36

Pan Wt 193.90 grams

Pan + Soil (wet) 336.95 grams

Pan + Soil (dry) 301.80 grams

Natural Moisture Content 32.6%



Sample ID LO-4 Sample Depth 28'-30'

# **Natural Moisture Content**

Pan ID 8

Pan Wt 187.28 grams

Pan + Soil (wet) 332.51 grams

Pan + Soil (dry) 296.41 grams

Natural Moisture Content 33.1%

Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



# Soil and Test Method Data

Sample ID L0-5

Sample Depth 2'-4'

Sample Classification #DIV/0!

USCS Group Symbol #DIV/0!

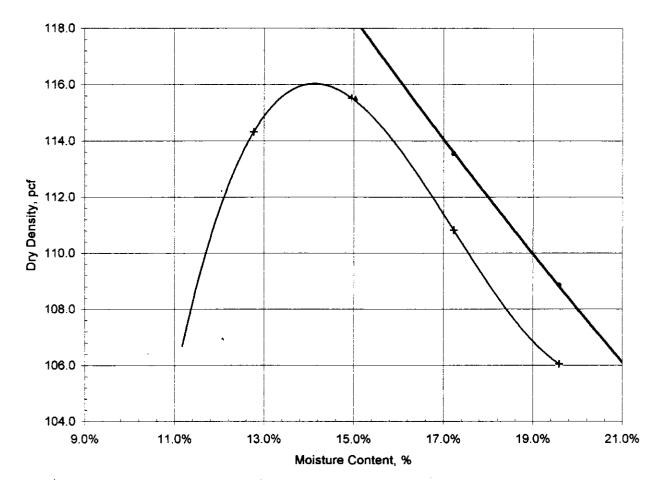
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	12.8%	15.0%	17.2%	19.6%	
Dry Density, ocf	114.3	115.5	110.8	106.0	

# Moisture-Density Curve



• Zero Air Voids + Proctor Points ▲ CBR Points

CBR Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID L0-5

Sample Depth 2'-4'

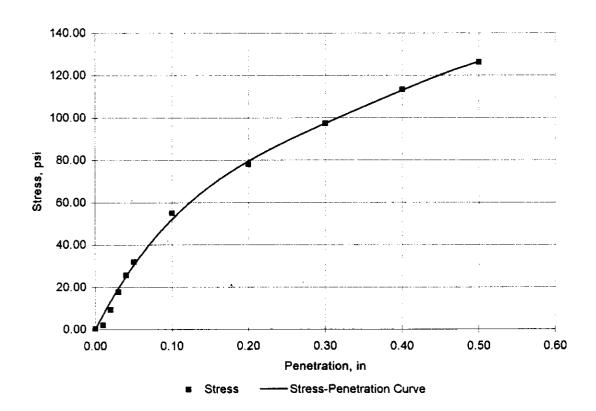
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	15.0%
Compacted Dry Density	115.5
Percent Compaction	100%
Percent Swell	0.3%
CBR @ 0.1"	5.5
CBR @ 0.2"	5.2



Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



# Soil and Test Method Data

Sample ID L0-6

Sample Depth 2'-4'

Sample Classification #DIV/0!

USCS Group Symbol #DIV/0!

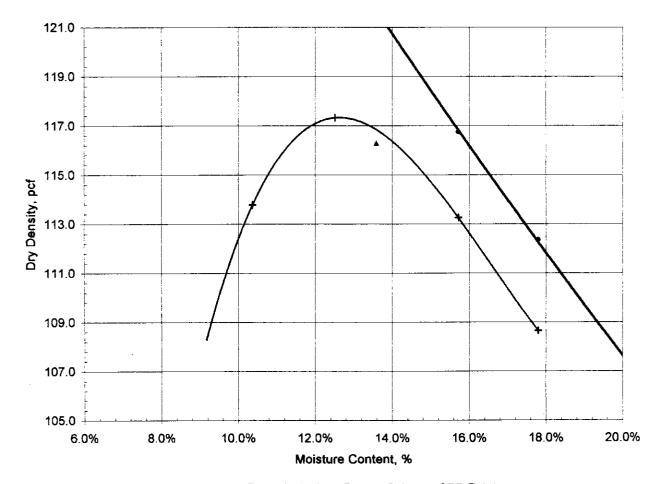
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data		#1	#2 .	#3	#4	#5
	Moisture Content	10.4%	12.5%	15.7%	17.8%	
	Dry Density, pcf	113.8	117.3	113.3	108.6	

# **Moisture-Density Curve**



Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



# Soil and Test Method Data

Sample ID L0-6

Sample Depth 2'-4'

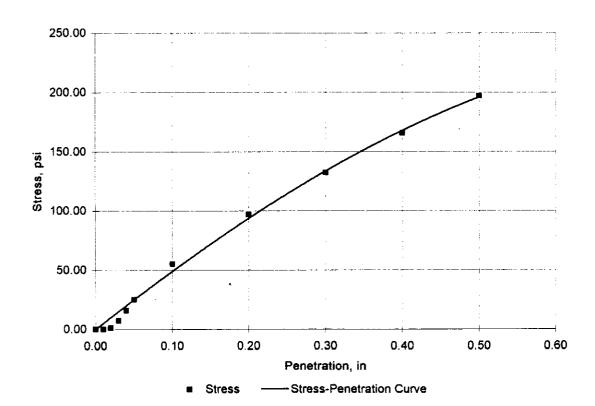
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	13.6%
Compacted Dry Density	116.3
Percent Compaction	99%
Percent Swell	0.4%
CBR @ 0.1"	5.5
CBR @ 0.2"	6.5



Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



# Soil and Test Method Data

Sample ID B0-1

Sample Depth 2'-4'

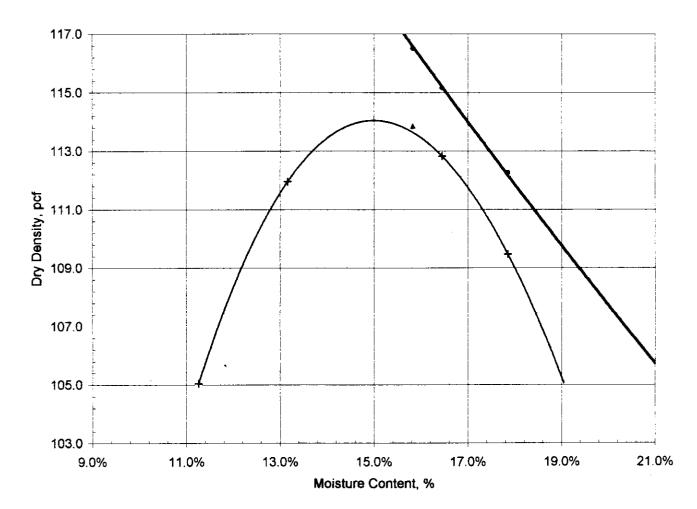
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data		#1	#2	#3	#4	#5
	Moisture Content	11.3%	13.2%	16.4%	17.8%	
	Dry Density, pcf	105.1	112.0	112.8	109.5	

# **Moisture-Density Curve**



• Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



# Soil and Test Method Data

Sample ID B0-1

Sample Depth 2'-4'

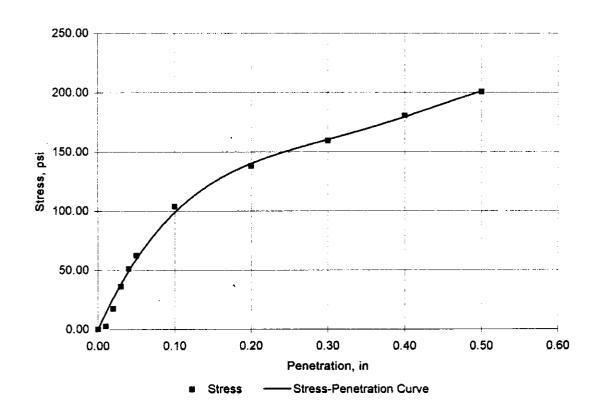
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

### **Test Data**

Compacted Moisture Content	15.8%
Compacted Dry Density	113.9
Percent Compaction	100%
Percent Swell	0.3%
CBR @ 0.1"	10.4
CBR @ 0.2"	9.2



Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



# Soil and Test Method Data

Sample ID B0-1A

Sample Depth 2'-4'

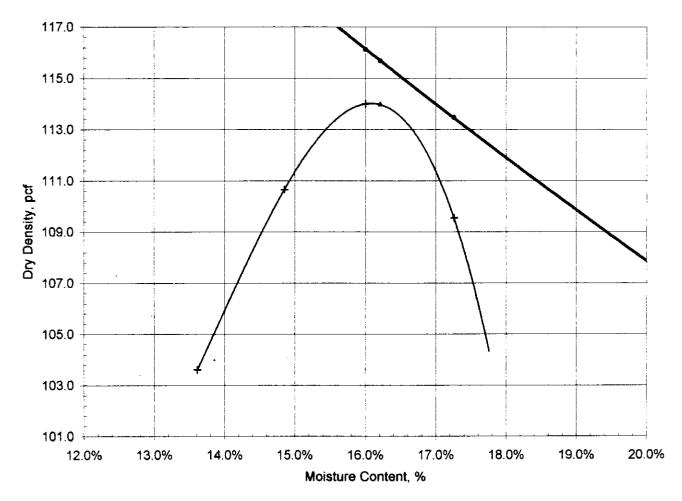
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data		#1	#2	#3	#4	#5
•	Moisture Content	16.0%	13.6%	14.8%	17.3%	
	Dry Density, pcf	114.0	103.6	110.7	109.5	

# Moisture-Density Curve



Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



#### Soil and Test Method Data

Sample ID B0-1A Sample Depth 2'-4'

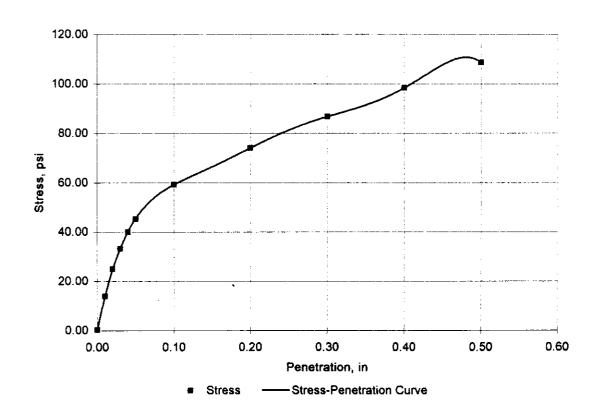
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	16.2%
Compacted Dry Density	114.0
Percent Compaction	100%
Percent Swell	0.5%
CBR @ 0.1"	5.9
CBR @ 0.2"	4.9



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 0-2

#### **Natural Moisture Content**

Pan ID 6

Pan Wt 194.72 grams

Pan + Soil (wet) 358.87 grams

Pan + Soil (dry) 334.46 grams

Natural Moisture Content 17.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 2'-4' Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

Pan ID 28

Pan Wt 193.21 grams

Pan + Soil (wet) 290.44 grams

Pan + Soil (dry) 276.67 grams

Natural Moisture Content 16.5%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 236.03 grams

Percent Passing No. 200 Sieve

48.7%

Pan + Soil retained on No. 4 sieve

(dry) 197.92 grams

Percent Passing No. 4 Sieve 94.4%

Soil Classifies as Coarse-Grained Soil

#### **Atterberg Limits**

**Liquid Limit** 

No of Blows	21	25	34
Pan ID	62	63	65
Pan Wt	10.89	10.73	10.99
Pan + Soil (wet)	24.45	18.17	20.01
Pan + Soil (dry)	20.60	16.11	17.65
Moisture Content	40%	38%	35%
Liquid Limit	39	38	37

Liquid Limit 38

**Plastic Limit** 

Pan ID K		18
Pan Weight	2.36	2.39
Pan + Soil (wet)	9.45	7.93
Pan + Soil (dry)	8.46	7.17
Moisture Content	16%	16%

Plastic Limit 16

Plastic Index 22

#### **USCS** Classification

Group Symbol SC

Group Name Clayey SAND

## **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

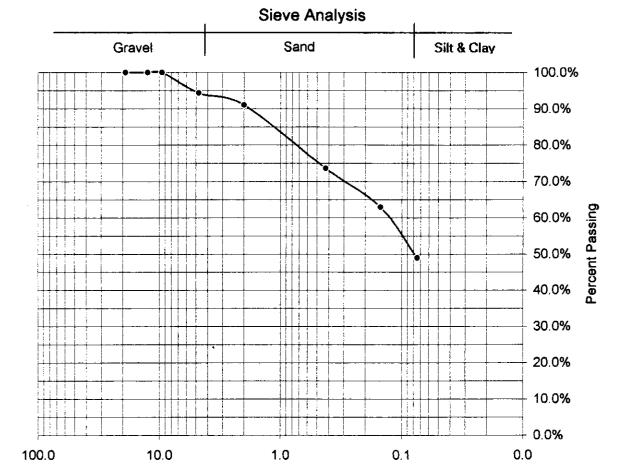
DAA # R01121-01 Prepared By: LTW

Sample ID B0-2 Sample Depth 2'-4'

Mechanical Sieve Analysis



Sieve Weight Percent Sieve Percent Size Retained Retained Size, mm Passing 3/4" 0.00 0.0% 19.0 100.0% 1/2" 0.00 0.0% 12.5 100.0% 3/8" 0.00 0.0% 9.5 100.0% No. 4 4.71 5.6% 4.75 94.4% No. 10 2.81 3.4% 2.0 91.0% No. 40 14.51 17.4% 0.425 73.6% No. 100 8.93 62.9% 10.7% 0.15 No. 200 11.68 14.0% 0.075 48.9% Pan 0.18 0.2% Total 42.82 51.1%



Sieve Size, mm

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 4'-6'

#### **Natural Moisture Content**

Pan ID 33

Pan Wt 193.70 grams

Pan + Soil (wet) 355.14 grams

Pan + Soil (dry) 326.87 grams

Natural Moisture Content 21.2%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 6'-8'

#### **Natural Moisture Content**

Pan ID 16

Pan Wt 189.42 grams

Pan + Soil (wet) 322.18 grams

Pan + Soil (dry) 290.55 grams

Natural Moisture Content 31.3%

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID BO-2 Sample Depth 8'-10' Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

Pan ID 16

Pan Wt 189.43 grams

Pan + Soil (wet) 360.08 grams

Pan + Soil (dry) 320.92 grams

Natural Moisture Content 29.8%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 295.27 grams

Percent Passing No. 200 Sieve 19.5%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 13'-15'

#### **Natural Moisture Content**

Pan ID 32

Pan Wt 191.68 grams

Pan + Soil (wet) 359.11 grams

Pan + Soil (dry) 318.68 grams

Natural Moisture Content 31.8%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 18'-20'

#### **Natural Moisture Content**

Pan ID 13

Pan Wt 187.40 grams

Pan + Soil (wet) 324.89 grams

Pan + Soil (dry) 290.82 grams

Natural Moisture Content 32.9%

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared By: LTW



Sample ID B0-2 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID 17

Pan Wt 188.65 grams

Pan + Soil (wet) 340.05 grams

Pan + Soil (dry) 302.72 grams

Natural Moisture Content 32.7%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID B0-2 Sample Depth 28'-30'

#### **Natural Moisture Content**

Pan ID 35

Pan Wt 192.74 grams

Pan + Soil (wet) 330.38 grams

Pan + Soil (dry) 297.30 grams

Natural Moisture Content 31.6%

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID BO-3
Sample Depth 6'-8'
Visual Sample Description Brown Gravelly SAND

#### **Natural Moisture Content**

 Pan ID
 40

 Pan Wt
 192.66 grams

 Pan + Soil (wet)
 339.03 grams

 Pan + Soil (dry)
 305.15 grams

 Natural Moisture Content
 30.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 283.67 grams Sieve 19.1%

Percent Passing No. 200 Sieve

Pan + Soil retained on No. 4 sieve

(dry) 216.13 grams

Percent Passing No. 4 Sieve 79.1%

Soil Classifies as Coarse-Grained Soil

## **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW

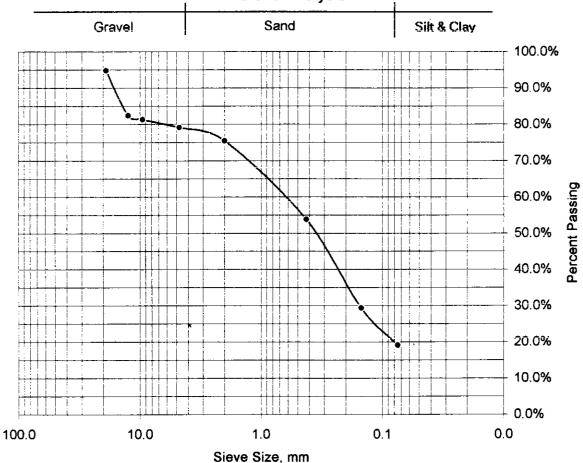
Sample ID BO-3
Sample Depth 6'-8'

Mechanical Sieve Analysis



Sieve Weight Percent Sieve Percent Size Retained Retained Size, mm Passing 3/4" 5.87 5.2% 19.0 94.8% 1/2" 13.90 12.4% 82.4% 12.5 3/8" 1.28 1.1% 9.5 81.3% No. 4 2.2% 2.42 4.75 79.1% No. 10 4.16 3.7% 2.0 75.4% 21.7% No. 40 24.37 0.425 53.8% No. 100 27.46 24.4% 0.15 29.4% No. 200 11.51 10.2% 0.075 19.1% Pan 0.38 0.3% Total 91.35 80.9%





Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID BO-3
Sample Depth 13'-15'
Visual Sample Description Brown SAND

#### **Natural Moisture Content**

Pan ID
Pan Wt
Pan Wt
Pan + Soil (wet)
Pan + Soil (dry)
Pan + Soil (dry)
Pan + Soil (dry)
Pan + Soil (dry)
Pan + Soil (dry)
Pan ID
194.51 grams
324.33 grams
292.69 grams
32.2%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 278.90 grams

Percent Passing No. 200 Sieve 14.0%

Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID B0-5

Sample Depth 2'-4'

Sample Classification #DIV/0!

USCS Group Symbol #DIV/0!

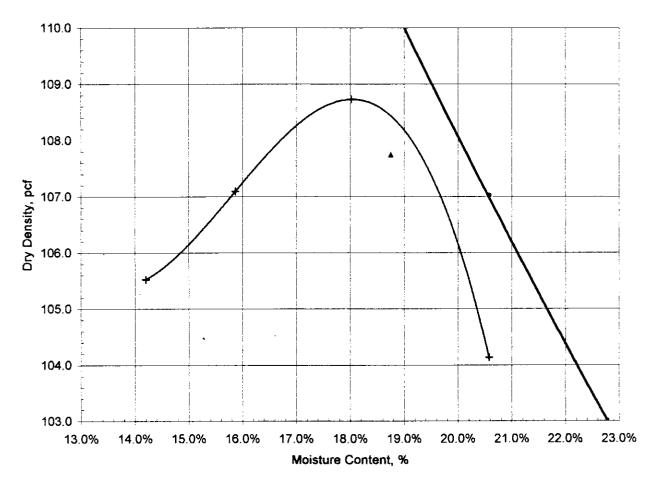
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data		#1	#2	#3	#4	#5
·-	Moisture Content	14.2%	15.9%	18.0%	20.6%	
	Dry Density, pcf	105.5	107.1	108.7	104.1	

#### Moisture-Density Curve



Zero Air Voids + Proctor Points ▲ CBR Points

CBR Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID B0-5

Sample Depth 2'-4'

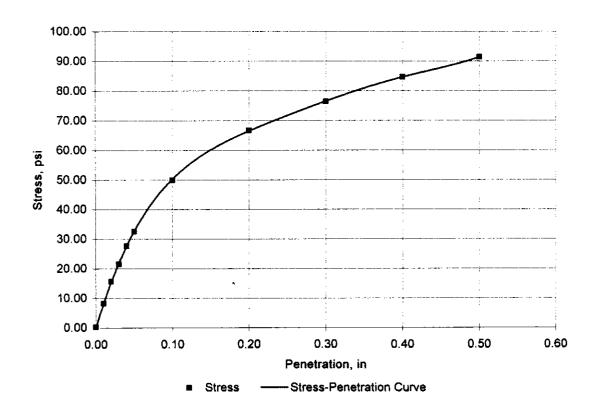
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	18.8%
Compacted Dry Density	107.8
Percent Compaction	99%
Percent Swell	0.4%
CBR @ 0.1"	5.0
CBR @ 0.2"	4.4



Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID B0-6

Sample Depth 2'-4'

Sample Classification #DIV/0!

USCS Group Symbol #DIV/0!

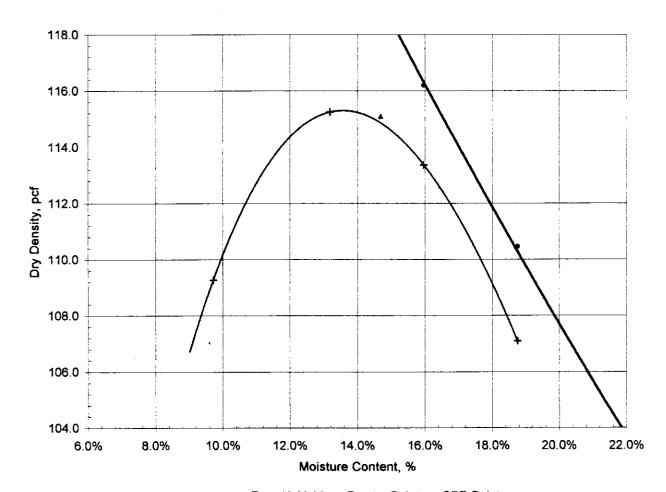
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data		#1	#2	#3	#4	#5
•	Moisture Content	9.7%	13.2%	16.0%	18.8%	<u> </u>
	Dry Density, pcf	109.3	115.3	113.4	107.1	

## **Moisture-Density Curve**



• Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



#### Soil and Test Method Data

Sample ID B0-6

Sample Depth 2'-4'

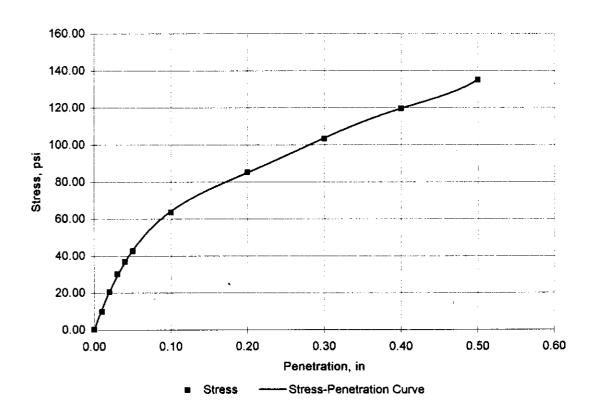
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

14.7%	Compacted Moisture Content
115.1	Compacted Dry Density
100%	Percent Compaction
0.4%	Percent Swell
6.4	CBR @ 0.1"
5.7	CBR @ 0.2"



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-1 Sample Depth 8-10' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

 Pan ID
 32

 Pan Wt
 191.74 grams

 Pan + Soil (wet)
 365.27 grams

 Pan + Soil (dry)
 319.90 grams

 Natural Moisture Content
 35.4%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 292.01 grams

Percent Passing No. 200 Sieve 21.8%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-1 Sample Depth 18-20' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

 Pan ID
 A106

 Pan Wt
 8.21 grams

 Pan + Soil (wet)
 141.42 grams

 Pan + Soil (dry)
 107.03 grams

 Natural Moisture Content
 34.8%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 92.11 grams

Percent Passing No. 200 Sieve 15.1%

Pan + Soil retained on No. 4 sieve

(dry) 8.21 grams

Percent Passing No. 4 Sieve 100.0%

Soil Classifies as Coarse-Grained Soil

**Draper Aden Associates** 

Blacksburg • Richmond, Virginia

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## **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW

Sample ID AMU-1

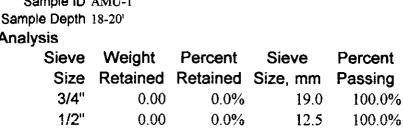
3/8"

No. 4

No. 10

Pan

Mechanical Sieve Analysis



No. 40 0.23 0.2% 0.425 99.7% No. 100 47.62 48.2% 51.5% 0.15 No. 200 35.32 35.7% 0.075 15.8%

0.6%

0.0%

0.0%

0.1%

9.5

4.75

2.0

100.0%

100.0%

99.9%

83.82 84.2% Total

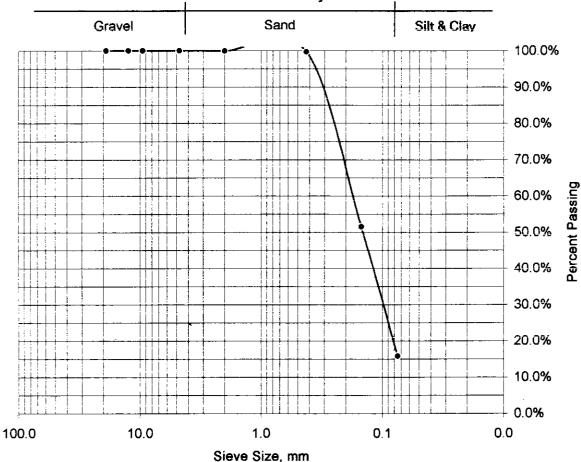
0.60

0.00

0.00

0.05

Sieve Analysis



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 0-2'

#### **Natural Moisture Content**

Pan ID 7

Pan Wt 192.35 grams

Pan + Soil (wet) 397.33 grams

Pan + Soil (dry) 380.00 grams

Natural Moisture Content 9.2%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 2'-4'

#### **Natural Moisture Content**

Pan ID 23

Pan Wt 194.03 grams

Pan + Soil (wet) 391.15 grams Pan + Soil (dry) 354.33 grams

Natural Moisture Content 23.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 4'-6' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID 18

Pan Wt 189.10 grams

Pan + Soil (wet) 304.16 grams

Pan + Soil (dry) 284.95 grams

Natural Moisture Content 20.0%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 253.60 grams

Percent Passing No. 200 Sieve 32

32.7%

Pan + Soil retained on No. 4 sieve

(dry) 192.43 grams

Percent Passing No. 4 Sieve 96.5%

Soil Classifies as Coarse-Grained Soil

## **Atterberg Limits**

Liquid Limit

No of Blows	18	28	34
Pan ID	70	69	72
Pan Wt	10.89	10.92	11.04
Pan + Soil (wet)	18.85	20,03	21.6
Pan + Soil (dry)	16.24	17.14	18.39
Moisture Content	49%	46%	44%
Liquid Limit	47	47	45

Plastic Limit

Pan ID	25 H	
Pan Weight	2.38	2.41
Pan + Soil (wet)	11.18	12.78
Pan + Soil (dṛy)	9.89	11.26
Moisture Content	17%	17%

47

Plastic Limit 17
Plastic Index 29

Liquid Limit

#### **USCS Classification**

Group Symbol SC

Group Name Clayey SAND

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## **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

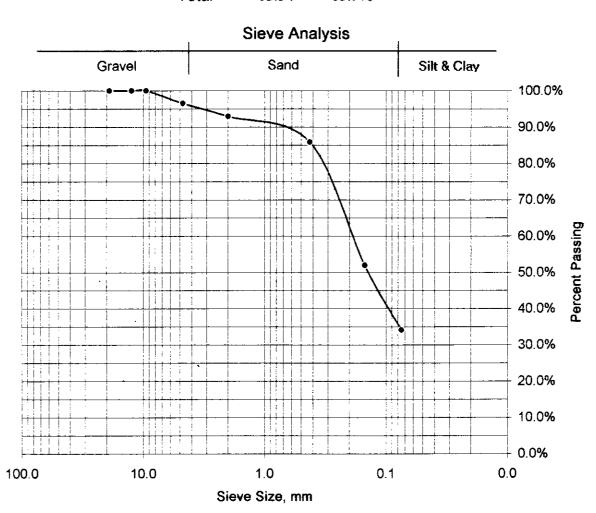
DAA # R01121-01

Prepared By: LTW

Sample ID AMU-2 Sample Depth 4'-6'

Mechanical Sieve Analysis

•				
Sieve	Weight	Percent	Sieve	Percent
Size	Retained	Retained	Size, mm	Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	3.33	3.5%	4.75	96.5%
No. 10	3.45	3.6%	2.0	92.9%
No. 40	6.73	7.0%	0.425	85.9%
No. 100	32.58	34.0%	0.15	51.9%
No. 200	17.03	17.8%	0.075	34.1%
Pan	0.22	0.2%		
Total	63.34	65.9%		



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 6'-8'

#### **Natural Moisture Content**

Pan ID 21

Pan Wt 198.41 grams

Pan + Soil (wet) 354.93 grams

Pan + Soil (dry) 316.55 grams

Natural Moisture Content 32.5%

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared By: LTW



Sample ID AMU-2 Sample Depth 8'-10'

#### **Natural Moisture Content**

Pan ID 20

Pan Wt 190.29 grams

Pan + Soil (wet) 332.11 grams

Pan + Soil (dry) 296.01 grams

Natural Moisture Content 34.1%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 13'-15'

#### **Natural Moisture Content**

Pan ID 40

Pan Wt 192.72 grams

Pan + Soil (wet) 325.00 grams

Pan + Soil (dry) 290.67 grams

Natural Moisture Content 35.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2
Sample Depth 18'-20'
Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 20

Pan Wt 189.95 grams

Pan + Soil (wet) 310.90 grams

Pan + Soil (dry) 278.24 grams

Natural Moisture Content 37.0%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

263.43 grams

Percent Passing No. 200 Sieve

16.8%

Pan + Soil retained on No. 4 sieve

(dry)

189.95 grams

Percent Passing No. 4 Sieve

100.0%

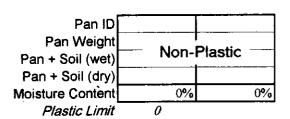
Soil Classifies as Coarse-Grained Soil

## **Atterberg Limits**

**Liquid Limit** 

No of Blows			
Pan ID			
Pan Wt		Non-Plastic	
Pan + Soil (wet)			
Pan + Soil (dry)			
Moisture Content	0%	0%	0%
Liquid Limit	0	NA	NA
Liquid Limit	0		

#### **Plastic Limit**



0

**USCS Classification** 

Group Symbol SM

Plastic Index

Group Name Silty SAND

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID 39

Pan Wt 192.99 grams

Pan + Soil (wet) 312.17 grams

Pan + Soil (dry) 282.70 grams

Natural Moisture Content 32.9%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 28'-30'

#### **Natural Moisture Content**

Pan ID 15

Pan Wt 188.51 grams

Pan + Soil (wet) 326.51 grams

Pan + Soil (dry) 291.02 grams

Natural Moisture Content 34.6%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 33'-35'

#### **Natural Moisture Content**

Pan ID 41

Pan Wt 196.43 grams

Pan + Soil (wet) 331.90 grams

Pan + Soil (dry) 297.50 grams

Natural Moisture Content 34.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 38'-40' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 3

Pan Wt 193.07 grams

Pan + Soil (wet) 308.90 grams

Pan + Soil (dry) 279.88 grams

Natural Moisture Content 33.4%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 260.38 grams

Percent Passing No. 200 Sieve 22.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 43'-45'

#### **Natural Moisture Content**

Pan ID 2

Pan Wt 196.25 grams

Pan + Soil (wet) 333.60 grams

Pan + Soil (dry) 299.64 grams

Natural Moisture Content 32.8%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 48'-50'

#### **Natural Moisture Content**

Pan ID 1

Pan Wt 195.44 grams

Pan + Soil (wet) 309.10 grams

Pan + Soil (dry) 280.02 grams

Natural Moisture Content 34.4%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 53'-55'

#### **Natural Moisture Content**

Pan ID 26

Pan Wt 194.56 grams

Pan + Soil (wet) 304.33 grams

Pan + Soil (dry) 275.31 grams

Natural Moisture Content 35.9%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-2 Sample Depth 58'-60'

#### **Natural Moisture Content**

Pan ID 18

Pan Wt 189.61 grams

Pan + Soil (wet) 317.78 grams

Pan + Soil (dry) 283.76 grams

Natural Moisture Content 36.1%

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID AMU-3 Sample Depth 2'-4' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID X5

Pan Wt

8.32 grams

Pan + Soil (wet)

159.22 grams

Pan + Soil (dry)

138.50 grams

Natural Moisture Content

15.9%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

91.39 grams

Percent Passing No. 200 Sieve

36.2%

Pan + Soil retained on No. 4 sieve

(dry)

15.12 grams

Percent Passing No. 4 Sieve

94.8%

Soil Classifies as Coarse-Grained Soil

#### **Atterberg Limits**

**Liquid Limit** 

No of Blows	18	23	33
Pan ID	1	7	9
Pan Wt	11.22	11.12	11.12
Pan + Soil (wet)	20,74	22.81	25.32
Pan + Soil (dry)	18.49	20.12	22.1
Moisture Content	31%	30%	29%
Liquid Limit	30	30	30

Liquid Limit 30

**Plastic Limit** 

Pan ID	32	52
Pan Weight	2.38	2.37
Pan + Soil (wet)	6.23	4.87
Pan + Soil (dry)	5.70	4.55
Moisture Content	16%	15%

SC

Plastic Limit 15

Plastic Index 14

**USCS Classification** 

Group Symbol

Group Name Clayey SAND

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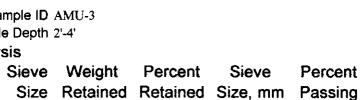
### **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

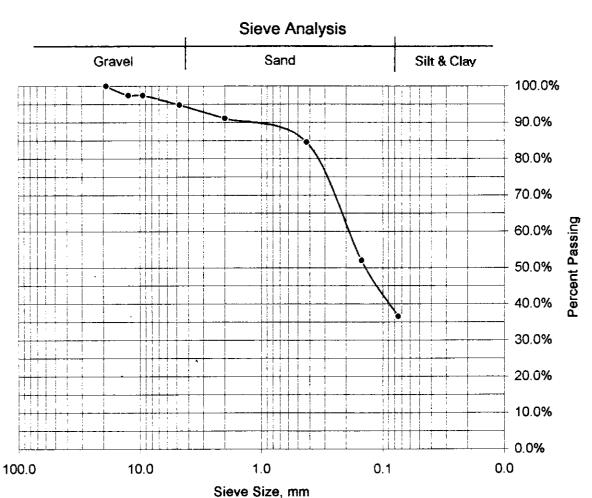
Prepared By: LTW

Sample ID AMU-3 Sample Depth 2'-4'

Mechanical Sieve Analysis



Retained Retained Size, mm Passing 3/4" 0.00 0.0% 19.0 100.0% 1/2" 3.37 2.6% 12.5 97.4% 3/8" 0.00 0.0% 9.5 97.4% No. 4 3.43 2.6% 4.75 94.8% No. 10 4.80 3.7% 2.0 91.1% No. 40 8.47 6.5% 0.425 84.6% 32.6% No. 100 42.50 51.9% 0.15 No. 200 20.01 15.4% 0.075 36.6% Pan 0.32 0.2% 82.90 63.4% Total



Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW

Sample ID AMU-3

Sample Depth 6'8'
Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID A109

Pan Wt 8.21 grams

Pan + Soil (wet) 143.83 grams

Pan + Soil (dry) 107.87 grams

Natural Moisture Content 36.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 88.71 grams

Percent Passing No. 200 Sieve 19.2%

Pan + Soil retained on No. 4 sieve

(dry) 8.21 grams

Percent Passing No. 4 Sieve 100.0%

Soil Classifies as Coarse-Grained Soil



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## **Grain Size Distribution Calculations**

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01.

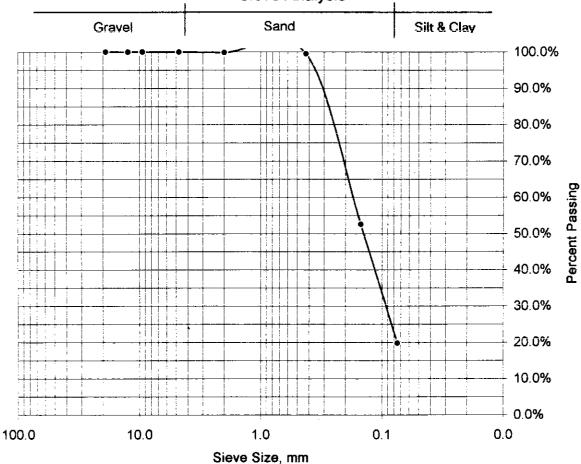
Prepared By: LTW

Sample ID AMU-3 Sample Depth 6'8'

Mechanical Sieve Analysis

Sieve	Weight	Percent	Sieve	Percent
Size	Retained	Retained	Size, mm	Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.17	0.2%	2.0	99.8%
No. 40	0.34	0.3%	0.425	99.5%
No. 100	46.80	47.0%	0.15	52.5%
No. 200	32.60	32.7%	0.075	19.8%
Pan	0.22	0.2%		
Total	80.13	80.2%		

#### Sieve Analysis



Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-5 Sample Depth 4-6' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID 17

Pan Wt 188.66 grams

Pan + Soil (wet) 290.60 grams

Pan + Soil (dry) 264.68 grams

Natural Moisture Content 34.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 246.80 grams

Percent Passing No. 200 Sieve 23.5%

Prepared By: LTW



Sample ID AMU-5 Sample Depth 13'-15' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 36

Pan Wt 193.68 grams

Pan + Soil (wet) 301.90 grams

Pan + Soil (dry) 273.19 grams

Natural Moisture Content 36.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

261.36 grams

Percent Passing No. 200 Sieve 14.9%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 2'-4' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID 20
Pan Wt 190.04 grams
Pan + Soil (wet) 369.09 grams
Pan + Soil (dry) 350.02 grams

Natural Moisture Content 11.9%

Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 318.36 grams

Percent Passing No. 200 Sieve 19.8%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 8'-10' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

 Pan ID
 6

 Pan Wt
 195.36 grams

 Pan + Soil (wet)
 297.87 grams

 Pan + Soil (dry)
 272.30 grams

 Natural Moisture Content
 33.2%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 258.22 grams

Percent Passing No. 200 Sieve 18.3%

Pan + Soil retained on No. 4 sieve

(dry) 195.36 grams

Percent Passing No. 4 Sieve 100.0%

Soil Classifies as Coarse-Grained Soil

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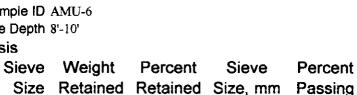
#### Grain Size Distribution Calculations

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW

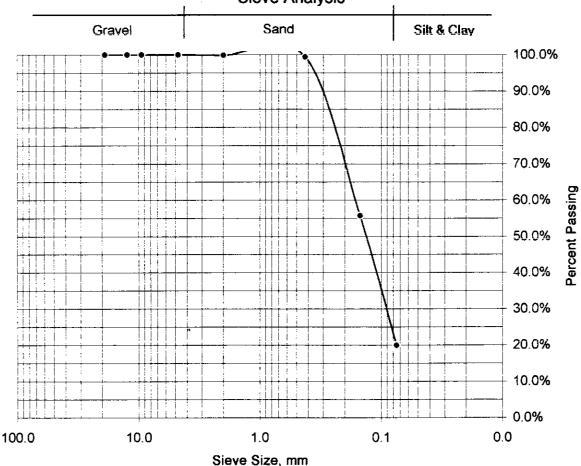
Sample ID AMU-6 Sample Depth 8'-10'

Mechanical Sieve Analysis



Passing 3/4" 0.00 0.0% 19.0 100.0% 1/2" 0.00 0.0% 12.5 100.0% 3/8" 0.00 0.0% 9.5 100.0% No. 4 0.00 0.0% 4.75 100.0% No. 10 0.10 0.1% 2.0 99.9% No. 40 0.35 0.5% 0.425 99.4% No. 100 33.65 43.7% 0.15 55.7% No. 200 27.48 0.075 20.0% 35.7% Pan 0.46 0.6% 62.04 80.0% Total

Sieve Analysis



Prepared By: LTW



Sample ID AMU-6 Sample Depth 4'-6'

#### **Natural Moisture Content**

Pan ID 38

Pan Wt 193.57 grams

Pan + Soil (wet) 358.98 grams Pan + Soil (dry) 327.12 grams

Natural Moisture Content 23.9%

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared By: LTW



Sample ID AMU-6 Sample Depth 6'-8'

#### **Natural Moisture Content**

Pan ID 6

Pan Wt 193.79 grams

Pan + Soil (wet) 375.28 grams

Pan + Soil (dry) 334.57 grams

Natural Moisture Content 28.9%

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared By: LTW

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Sample ID AMU-6 Sample Depth 13'-15'

#### **Natural Moisture Content**

Pan ID 22

Pan Wt 189,02 grams

Pan + Soil (wet) 355.08 grams

Pan + Soil (dry) 313.87 grams

Natural Moisture Content 33.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 18'-20'

#### **Natural Moisture Content**

Pan ID

Pan Wt 194.44 grams

Pan + Soil (wet) 337.91 grams

Pan + Soil (dry) 300.21 grams

Natural Moisture Content 35.6%

DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID 30

Pan Wt 193.54 grams

Pan + Soil (wet) 328.31 grams

294.55 grams Pan + Soil (dry)

Natural Moisture Content 33.4%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 28'-30'

#### **Natural Moisture Content**

Pan ID 10

Pan Wt 183.99 grams

Pan + Soil (wet) 288.57 grams

Pan + Soil (dry) 263.21 grams

Natural Moisture Content 32.0%

Prepared By: LTW



Sample ID AMU-6 Sample Depth 33'-35'

#### **Natural Moisture Content**

Pan ID 42

Pan Wt 192.21 grams

Pan + Soil (wet) 318.00 grams

Pan + Soil (dry) 287.82 grams

Natural Moisture Content 31.6%

Prepared By: LTW



Sample ID AMU-6 Sample Depth 38'-40'

#### **Natural Moisture Content**

Pan ID 27

Pan Wt 193.75 grams

Pan + Soil (wet) 336.24 grams

Pan + Soil (dry) 303.46 grams

Natural Moisture Content 29.9%

Prepared By: LTW



Sample ID AMU-6 Sample Depth 43'-45'

#### **Natural Moisture Content**

Pan ID A-106

Pan Wt 8.33 grams

Pan + Soil (wet) 114.79 grams

Pan + Soil (dry) 85.85 grams

Natural Moisture Content 37.3%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 48'-50'

#### **Natural Moisture Content**

Pan ID 3

Pan Wt

192.10 grams

Pan + Soil (wet)

324.17 grams

Pan + Soil (dry)

288.14 grams

Natural Moisture Content

37.5%

Prepared By: LTW



Sample ID AMU-6 Sample Depth 53'-55'

#### **Natural Moisture Content**

Pan ID 25

Pan Wt

194.72 grams

Pan + Soil (wet)

383.29 grams

Pan + Soil (dry)

333.73 grams

Natural Moisture Content

35.7%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 58'-60'

#### **Natural Moisture Content**

Pan ID 24

Pan Wt

189.63 grams

Pan + Soil (wet)

300.74 grams

Pan + Soil (dry)

269.54 grams

Natural Moisture Content

39.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-6 Sample Depth 63'-65'

#### **Natural Moisture Content**

Pan ID

Pan Wt 187.32 grams

Pan + Soil (wet) 333.34 grams

Pan + Soil (dry) 295.00 grams

Natural Moisture Content 35.6%

Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID AMU-7

Sample Depth 2'-4'

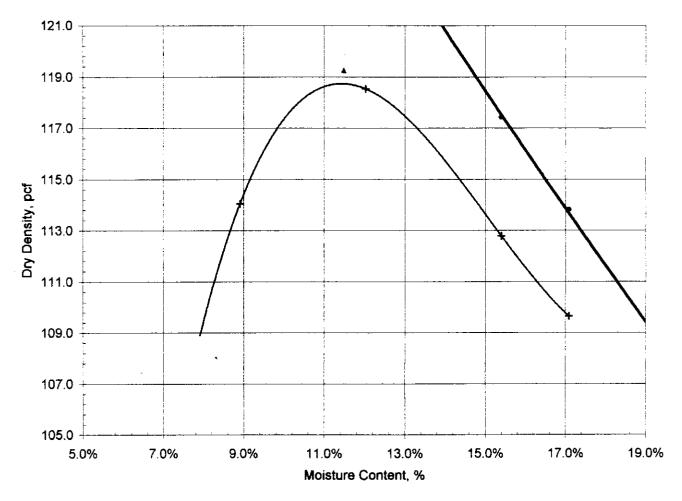
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	8.9%	12.0%	15.4%	17.1%	
Dry Density, pcf	114.0	118.5	112.8	109.6	

#### **Moisture-Density Curve**



Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



#### Soil and Test Method Data

Sample ID AMU-7

Sample Depth 2'-4'

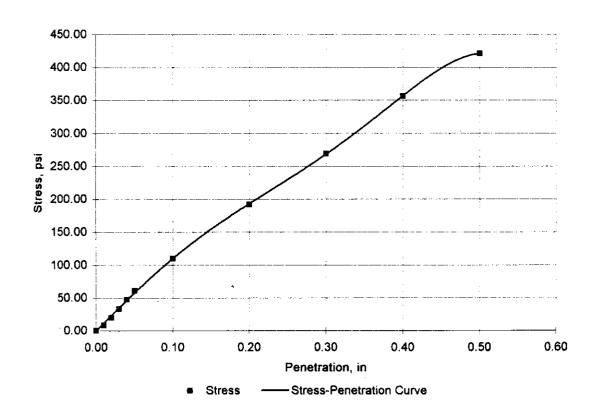
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	11.5%
Compacted Dry Density	119.3
Percent Compaction	100%
Percent Swell	-0.3%
CBR @ 0.1"	11.0
CBR @ 0.2"	12.8



Proctor Test Report
Langley AFB, F-22 Bed-down Facility
DAA # R01121-01
Prepared by LTW



#### Soil and Test Method Data

Sample ID AMU-8

Sample Depth 2'-4'

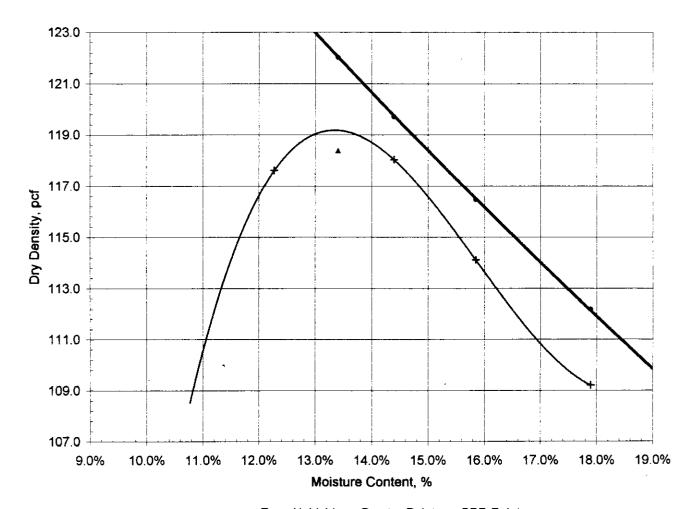
Test Method ASTM D698, Method B, with mechanical hammer

Sample Preparation Air dried and sieved through a 3/8" sieve.

Mold Size, in 4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	12.3%	14.4%	15.8%	17.9%	
Dry Density, pcf	117.6	118.0	114.1	109.2	

#### Moisture-Density Curve



• Zero Air Voids + Proctor Points ▲ CBR Points

# CBR Test Report Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared by LTW



#### Soil and Test Method Data

Sample ID AMU-8

Sample Depth 2'-4'

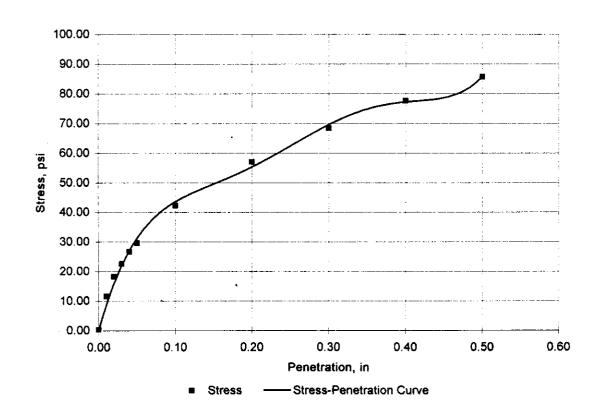
Test Method ASTM D1883, compacted with mechanical hammer

Sample Preparation Air dried, sieved through a 3/8" sieve and moisture conditioned.

Soak >96 hours

#### **Test Data**

Compacted Moisture Content	13.4%
Compacted Dry Density	118.4
Percent Compaction	100%
Percent Swell	0.3%
CBR @ 0.1"	4.2
CBR @ 0.2"	3.8



Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW

Sample ID AMU-9 Sample Depth 0'-2'

#### **Natural Moisture Content**

Pan ID 34

Pan Wt

192.80 grams

Pan + Soil (wet) 378.33 grams

Pan + Soil (dry) 358.11 grams

Natural Moisture Content 12.2%



Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID AMU-9 Sample Depth 2'-4' Visual Sample Description Gray Clayey SAND

#### **Natural Moisture Content**

Pan ID X4

Pan Wt

8.34 grams

Pan + Soil (wet)

142.66 grams

Pan + Soil (dry)

120.69 grams

Natural Moisture Content

19.6%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

57.71 grams

Percent Passing No. 200 Sieve

56.1%

Pan + Soil retained on No. 4 sieve

(dry)

8.34 grams

Percent Passing No. 4 Sieve

100.0%

Soil Classifies as Fine-Grained Soil

#### **Atterberg Limits**

Liquid Limit

No of Blows	16	20	34
Pan ID	94	101	108
Pan Wt	23.84	23.98	33.14
Pan + Soil (wet)	34.24	31.56	46.81
Pan + Soil (dry)	31.08	29.38	43.1
Moisture Content	44%	40%	37%
Liquid Limit	41	39	39

Liquid Limit 40

Plastic Limit

Pan ID	26	30
Pan Weight	2.35	2.40
Pan + Soil (wet)	7.66	8.28
Pan + Soil (dry)	6.84	7.38
Moisture Content	18%	18%

Plastic Limit 18 Plastic Index 21

**USCS Classification** 

Group Symbol CL

Group Name Sandy Lean CLAY

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# **Grain Size Distribution Calculations**

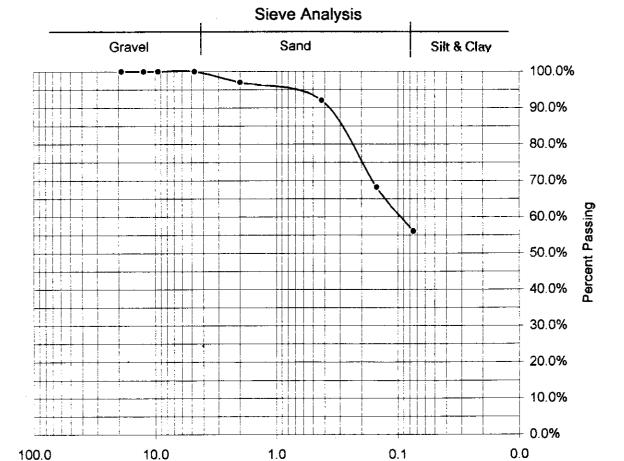
Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW

Sample ID AMU-9 Sample Depth 2'-4'

Mechanical Sieve Analysis

Sieve	Weight	Percent	Sieve	Percent
Size	Retained	Retained	Size, mm	Passing
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	3,39	3.0%	2.0	97.0%
No. 40	5.52	4.9%	0.425	92.1%
No. 100	26.84	23.9%	0.15	68.2%
No. 200	13.66	12.2%	0.075	56.0%
Pan	0.17	0.2%		
Total	49.58	44.0%		



Sieve Size, mm

DAA # R01121-01

Prepared By: LTW



Sample ID AMU-9 Sample Depth 4'-6'

#### **Natural Moisture Content**

Pan ID 11

Pan Wt

187.89 grams

Pan + Soil (wet)

379.67 grams

Pan + Soil (dry)

351.82 grams

Natural Moisture Content

17.0%

Prepared By: LTW



Sample ID AMU-9
Sample Depth 6'-8'
Visual Sample Description Gray/brown Coarse SAND w/ trace of Clay

#### **Natural Moisture Content**

Pan ID 25

Pan Wt 194.04 grams

Pan + Soil (wet) 321.90 grams

Pan + Soil (dry) 308.23 grams

Natural Moisture Content 12.0%

Coarse or Fine Grained

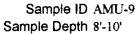
Pan + Soil retained on No. 200 sieve

(dry) 292.21 grams

Percent Passing No. 200 Sieve 14.0%

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW



#### **Natural Moisture Content**

Pan ID 37

Pan Wt

194.22 grams

Pan + Soil (wet)

395.39 grams

Pan + Soil (dry)

343.67 grams

Natural Moisture Content

34.6%

**Draper Aden Associates** 

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Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-9 Sample Depth 13'-15' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 40

Pan Wt 192.65 grams

Pan + Soil (wet) 277.60 grams

Pan + Soil (dry) 256.34 grams

Natural Moisture Content 33.4%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 246.78 grams

Percent Passing No. 200 Sieve 15.0%

Prepared By: LTW



Sample ID AMU-9 Sample Depth 18-20'

#### **Natural Moisture Content**

Pan ID

Pan Wt 194.24 grams

Pan + Soil (wet) 335.74 grams

300.20 grams Pan + Soil (dry)

Natural Moisture Content 33.5%

### Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01 Prepared By: LTW



Sample ID AMU-9 Sample Depth 23'-25'

#### **Natural Moisture Content**

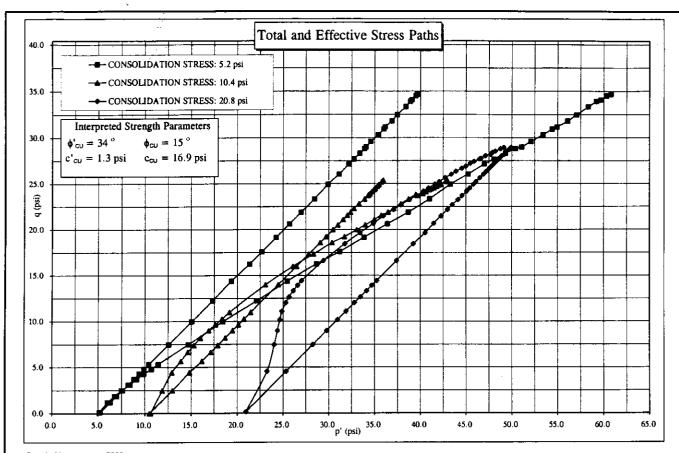
Pan ID 24

Pan Wt

186.25 grams

Pan + Soil (wet) 327.54 grams Pan + Soil (dry) 292.25 grams

Natural Moisture Content 33.3%



Sample No.: 788 Exploration No.: AM

Exploration No.: AMU-9 Sample I.D. / Depth: 23-25 feet

i		SAMPLE NO.										
		7882A	7882B	7882C		Sieve Size						
INITIAL	Wet Weight, g	130.2	135.0	144.3	Z	3/8-in (9.5-mm)		-		Liquid Limit, %	-	
	Dry Weight, g	97.9	100.0	106.9	2	No. 4 (4.75-mm)	9.0	•	Plastic Limit, % -		-	
	Water Content, %	33.0	35.0	35.0	D.	No. 10 (2.0-mm)	Passing	-	Plasticity Index, %		-	
	Wet Density, pcf	117.0	116.0	118.0	GRADATION	No. 40 (0.425-mm)	g.	-		Classification	•	
	Dry Density, pcf	88.0	85.9	87.4	5	No. 100 (0.150-mm)	٠,	-	Est.	Specific Gravity	2.7	
	Saturation, %	97.4	98.4	100.0		No. 200 (0.075-mm)		-				
	Void Ratio	0.92	0.96	0.94								
	Diameter, in	1.362	1.370	1.383								
	Height, in	2.908	3.006	3.100				7882A	7882B	7882C		
	Saturation Method	Wet	Wet	Wet		Strain Rate, %/min		0.12	0.26	0.24		
					<u>~</u>	Cell Pressure, psi		45.2	50.4	60.8		
	B-Parameter	1.00	1.00	0.98	<u>`</u>	Back Pressure, psi		40.0	40.0	40.0		
	t <sub>50</sub> , minutes	3.2	1.6	1.7	Ì	σ <sub>3CON</sub> , psi		5.2	10.4	20.8		
						Failure Criteria		15.0%	$\sigma_{DMAX}$	15.0%		
AT TEST	Wet Weight, g	130.0	133.9	142.7	TEST SUMMARY	σ <sub>DMAX</sub> , psi*		69.2	50.7	57.7		
	Dry Weight, g	97.9	100.0	106.9	<b>E</b>	Axial Strain at Failure, %	;	15.0	14.7	15.0		
	Water Content, %	32.8	33.9	33.5	I	σ <sub>iF</sub> , psi*		92.5	68.3	77.9		
	Wet Density, pcf	118.3	116.7	119.1		σ <sub>3F</sub> , psi*		23.3	17.6	20.2		
	Dry Density, pcf	1.98	87.1	89.2								
	Saturation, %	99.4	98.1	100.0		*Filter paper and membrane corrections have been applied.						
	Void Ratio	0.89	0.93	0.91	3	Sample collection, handling methods, and other factors not disclosed to the laboratory testing firm could have affected the test results and the values reported. The test results are based upon interpretation of data collected through the test process. These interpretations do not consider the specifics of the project to which they will be applied. Therefore, all test results must be confirmed by a qualified geotechnical engineer for consistency with their intended use.						
	Area, in <sup>2</sup>	1.445	1.461	1.481	REMARKS							
	Diameter, in	1.356	1.364	1.373	EM							
	Height, in	2.896	2.992	3.084	≅							



Virginia Geotechnical Services, P.C.

8211 Hermitage Road Richmond, Virginia 23228 Telephone: (804) 266-2199

Fax: (804) 261-5569

ISOTROPICALLY CONSOLIDATED, UNDRAINED TRIAXIAL TEST (ASTM D4767)

Project: Langley Air Force Base (F-22)

Client: EEE Consulting

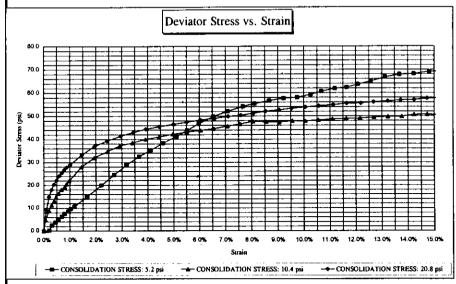
Location: Hampton, VA
Project No.: GT1688

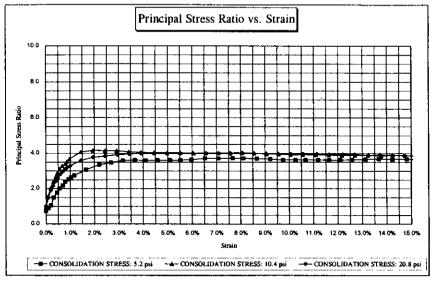
Page 1 of 3

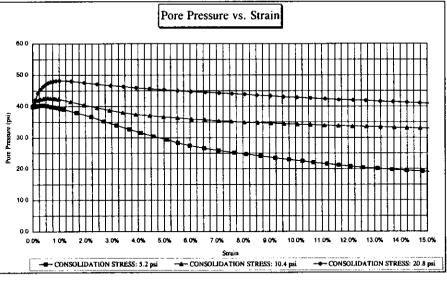
Sample No.: Exploration No.: 7882

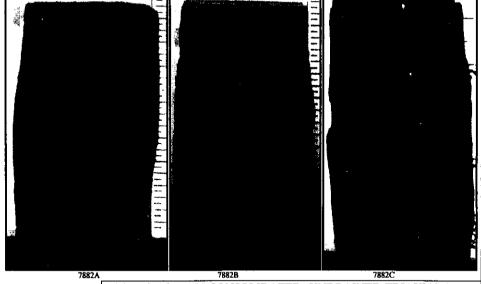
Sample I.D. / Depth: 23-25 feet

AMU-9











Virginia Geotechnical Services, P.C.

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Fax: (804) 261-5569

ISOTROPICALLY CONSOLIDATED, UNDRAINED TRIAXIAL TEST

Project:

Langley Air Force Base (F-22)

Client:

EEE, Consulting

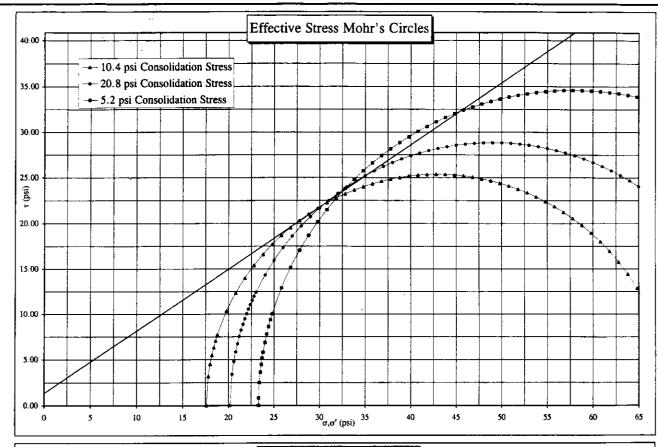
Location:

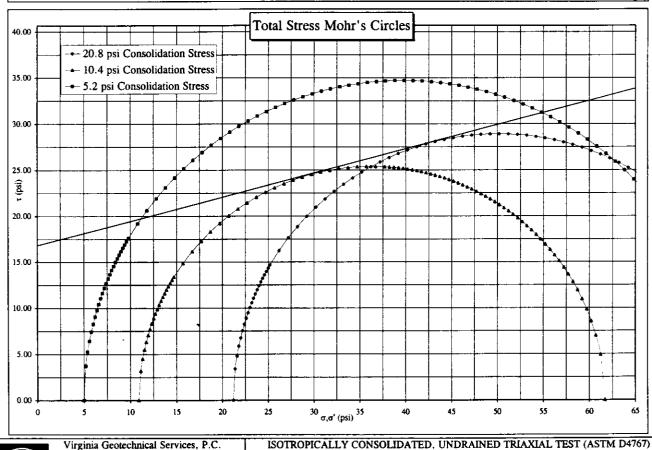
Hampton, VA

Project No.:

GT1688

Page 2 of 3







Virginia Geotechnical Services, P.C.

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Langley Air Force Base (F-22)

Project:

Client:

**EEE Consulting** 

Location: Project No.: Hampton, VA GT1688

Page 3 of 3

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID AMU-9 Sample Depth 28'-30'

#### **Natural Moisture Content**

Pan ID 12

Pan Wt

184.93 grams

Pan + Soil (wet)

371.15 grams

Pan + Soil (dry)

324.03 grams

Natural Moisture Content

33.9%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID AMU-9 Sample Depth 33'-35'

#### **Natural Moisture Content**

Pan ID 29

Pan Wt 191.89 grams

Pan + Soil (wet) 384.46 grams

Pan + Soil (dry) 316.80 grams

Natural Moisture Content 54.2%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW



Sample ID PH-1 Sample Depth 0'-2'

#### **Natural Moisture Content**

Pan ID A112

Pan Wt

8.28 grams Pan + Soil (wet) 151.09 grams

Pan + Soil (dry) 138.02 grams

Natural Moisture Content 10.1%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 2'-4'

#### **Natural Moisture Content**

Pan ID A113

Pan Wt

8.57 grams

Pan + Soil (wet)

124.75 grams

Pan + Soil (dry)

109.99 grams

Natural Moisture Content

14.6%

# Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 4'-6'

#### **Natural Moisture Content**

Pan ID A111

Pan Wt 8.15 grams

Pan + Soil (wet) 78.56 grams

Pan + Soil (dry) 66.81 grams

Natural Moisture Content 20.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 6'-8' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID A113

Pan Wt 8.16 grams

Pan + Soil (wet) 110.70 grams

Pan + Soil (dry) 92.36 grams

Natural Moisture Content 21.8%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry)

69.46 grams

Percent Passing No. 200 Sieve

27.2%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 8'-10' Visual Sample Description Brown/Gray Silty SAND

#### **Natural Moisture Content**

Pan ID A112

Pan Wt 8.16 grams

Pan + Soil (wet) 129.88 grams

Pan + Soil (dry) 101.10 grams

Natural Moisture Content 31.0%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 80.93 grams

Percent Passing No. 200 Sieve 21.7%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 13'-15'

#### **Natural Moisture Content**

Pan ID A109

Pan Wt 8.24 grams

Pan + Soil (wet) 156.77 grams

Pan + Soil (dry) 117.88 grams

Natural Moisture Content 35.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 18'-20'

#### **Natural Moisture Content**

Pan ID A107

Pan Wt 8

8.14 grams

Pan + Soil (wet) 129.47 grams Pan + Soil (dry) 98.01 grams

1 '11 - Oon (ary) 25.01

Natural Moisture Content 35.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID A104

Pan Wt 8.26 grams

Pan + Soil (wet) 149.66 grams

Pan + Soil (dry) 114.16 grams

Natural Moisture Content 33.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 28'-30'

#### **Natural Moisture Content**

Pan ID A101

Pan Wt 8.19 grams

Pan + Soil (wet) 119.64 grams

Pan + Soil (dry) 92.00 grams

Natural Moisture Content 33.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 33'-35'

#### **Natural Moisture Content**

Pan ID A103

Pan Wt 8.23 grams

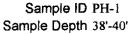
Pan + Soil (wet) 150.73 grams

Pan + Soil (dry) 114.68 grams

Natural Moisture Content 33.9%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility

DAA # R01121-01 Prepared By: LTW



#### **Natural Moisture Content**

Pan ID A108

Pan Wt

8.18 grams 116.10 grams

Pan + Soil (wet)

Pan + Soil (dry)

86.61 grams

Natural Moisture Content

37.6%

**Draper Aden Associates** 

Blacksburg + Richmond, Virginia

Engineering • Surveying • Environmental Services

Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW

**Draper Aden Associates** Blacksburg • Richmond, Virginia Engineering • Surveying • Environmental Services

Sample ID PH-1 Sample Depth 43'-45'

#### **Natural Moisture Content**

Pan ID A100

Pan Wt

8.67 grams

Pan + Soil (wet)

167.92 grams

Pan + Soil (dry)

126.14 grams

Natural Moisture Content

35.6%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID PH-1 Sample Depth 48'-50'

#### **Natural Moisture Content**

Pan ID M-15

Pan Wt

8.21 grams

Pan + Soil (wet)

132.90 grams

Pan + Soil (dry)

100.02 grams

Natural Moisture Content

35.8%

## **Soil Classification Calculations** Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 0'-2'

#### **Natural Moisture Content**

Pan ID

Pan Wt 193.14 grams

Pan + Soil (wet) 347.74 grams Pan + Soil (dry) 333.38 grams

Natural Moisture Content 10.2%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1
Sample Depth 2'-4'
Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

 Pan ID
 22

 Pan Wt
 189.01 grams

 Pan + Soil (wet)
 320.48 grams

 Pan + Soil (dry)
 301.56 grams

 Natural Moisture Content
 16.8%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 260.47 grams
Percent Passing No. 200 Sieve 36.5%

Pan + Soil retained on No. 4 sieve

(dry) 191.71 grams Percent Passing No. 4 Sieve 97.6%

Soil Classifies as Coarse-Grained Soil

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

## **Grain Size Distribution Calculations**

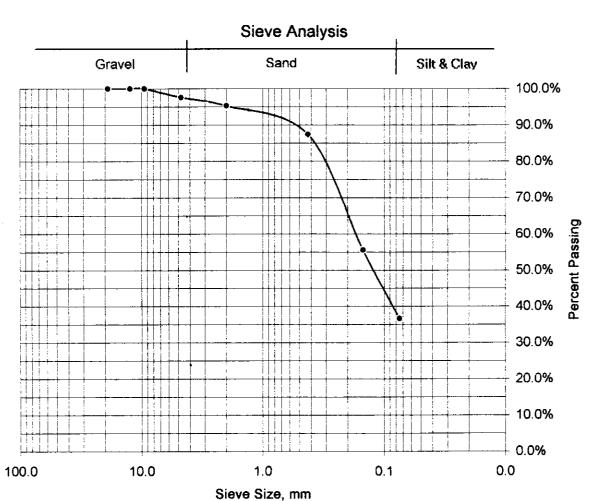
Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW

Sample ID VT-1 Sample Depth 2'-4'

#### Mechanical Sieve Analysis

Sieve	Weight	Percent	Sieve	Percent	
Size	Retained	Retained	Size, mm	Passing	
3/4"	0.00	0.0%	19.0	100.0%	
1/2"	0.00	0.0%	12.5	100.0%	
3/8"	0.00	0.0%	9.5	100.0%	
No. 4	2.70	2.4%	4,75	97.6%	
No. 10	2.62	2.3%	2.0	95.3%	
No. 40	8.85	7.9%	0.425	87.4%	
No. 100	35.87	31.9%	0.15	55.5%	
No. 200	21.28	18.9%	0.075	36.6%	
Pan	0.21	0.2%			
Total	71.53	63.4%			



## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 4'-6'

#### **Natural Moisture Content**

Pan ID 34

Pan Wt 192.76 grams

Pan + Soil (wet) 320.48 grams

Pan + Soil (dry) 295.02 grams

Natural Moisture Content 24.9%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 8'-10'

#### **Natural Moisture Content**

Pan ID

Pan Wt

195.06 grams Pan + Soil (wet) 344.36 grams

Pan + Soil (dry) 309.06 grams

Natural Moisture Content 31.0%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 13'-15' Visual Sample Description Gray Silty SAND

#### **Natural Moisture Content**

Pan ID 30
Pan Wt 193.57 grams
Pan + Soil (wet) 354.39 grams
Pan + Soil (dry) 313.75 grams

Natural Moisture Content 33.8%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 296.97 grams

Percent Passing No. 200 Sieve 14.0%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 18'-20'

#### **Natural Moisture Content**

Pan ID 29

Pan Wt 192.06 grams

Pan + Soil (wet) 337.38 grams

Pan + Soil (dry) 303.68 grams

Natural Moisture Content 30.2%

## Soil Classification Calculations Langley AFB, F-22 Bed-down Facility

DAA # R01121-01

Prepared By: LTW



Sample ID VT-1 Sample Depth 23'-25'

#### **Natural Moisture Content**

Pan ID 11

Pan Wt 187.80 grams

Pan + Soil (wet) 313.62 grams

Pan + Soil (dry) 287.26 grams

Natural Moisture Content 26.5%

Langley AFB, F-22 Bed-down Facility DAA # R01121-01

Prepared By: LTW



Sample ID VT-2 Sample Depth 2'-4' Visual Sample Description Brown Clayey SAND

#### **Natural Moisture Content**

 Pan ID
 36

 Pan Wt
 193.81 grams

 Pan + Soil (wet)
 315.08 grams

 Pan + Soil (dry)
 296.50 grams

 Natural Moisture Content
 18.1%

#### Coarse or Fine Grained

Pan + Soil retained on No. 200 sieve

(dry) 250.50 grams
Percent Passing No. 200 Sieve 44.8%

R01121-01, VT-2, 2'-4'